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WANTED—A NAME.

Thus far there seems to be no consensus of opinion as to the proper name to be given to the shadow prints produced by Röntgen rays. While *radiograph* was one of the earliest terms used in Europe and this country by scientists of standing, it is yet not altogether satisfactory on account of its generality, including as it does the photograph. *Skotograph* or *scotograph* and *sciagraph* are etymologically correct, but appear to have been viewed with suspicion as tinged with pedantry, and *shadowgraph* is a mongrel word not to be tolerated. *X-ray* is absolutely inexcusable, and *cathodograph* no less so, being a misnomer due to the ignorance that at first existed as to the character of the new rays. *Röntgraph*, were it not for the appearance of the word and its sound, would be a satisfactory term, but these objections would militate against its popular adoption. The modesty of the discoverer of the phenomenon would doubtless prohibit him from definitely settling the matter by a mere suggestion, as he undoubtedly could, and it is therefore desirable that those whose word is authority should take up the matter for determination.

DIRECT VS. ALTERNATING-CURRENT ARCS.

We have several times referred to the subject of the comparative efficiency of direct and alternating-current arcs, and expressed the opinion that it could not be held proven that one was superior to the other unless it were shown that each was tested under its best conditions with respect to length of arc, quality of carbon, size of carbon, voltage and current. This subject has recently been under discussion before the Physical Society of England. Prof. S. P. Thompson held that there is no inherent superiority in the direct-current over the alternating arc, while Prof. Ayrton modified a previous statement, to the effect that the latter is necessarily less efficient than the former. Prof. Fleming and Mr. Petevel, on the other hand, believe that a direct-current arc may be twice as efficient as one generated by an alternating current. We learn from our London contemporary, *The Electrician*, which comments rather sarcastically upon this divergence in views, that some experiments are to be undertaken by Prof. Fleming and Mr. Petevel on the lines we have indicated above, and which, it is to be hoped, will finally result in clearing up a matter which has been the subject of considerable controversy and of much unscientific experimentation.

RÖNTGEN RAY EXPERIMENTS.

On another page Drs. Houston and Kennelly give an interesting résumé of the result of Mr. Edison's experiments to date on Röntgen rays which, as remarked, cannot fail to be of value to other workers in the field. The most notable conclusion reached is that there is no apparent advantage in obtaining a very high vacuum in the ray lamp, and a criterion is given by means of which the proper degree of vacuum may be recognized. As, however, it is known that the degree of vacuum may increase in such tubes with use, the importance of this fact would seem to be lessened. That the thickness of the glass affects the result was perhaps to have been expected, but it is gratifying to have that point established beyond peradventure, as well as the rate of variation of the Röntgen effect with the fluorescence, with the distance of the sensitive plate from the source of rays and with the size of the lamp. The ray-lamp described offers a definitive form to experimenters, who hitherto have been largely groping in the dark as to the necessary qualifications. As will be seen, all of the conclusions noted refer to an exciting current of moderate frequency and E. M. F., such as obtained from a Ruhmkorff coil. Judging from the excellent results secured in the

Shallenberger laboratory with very high E. E. Fs., and enormous frequencies obtained by means of disruptive gaps, this latter method is peculiarly fitted for generating Röntgen rays. It would, therefore, be interesting to determine if the same conclusions apply in both cases, as those that do would thus be firmly established. It may be remarked that one of the most notable advantages of the latter system is that there is no danger from the destruction of tubes by heated electrodes—so often a source of considerable trouble and expense. Those who read the report of Mr. Edison's most recent work as presented by Drs. Houston and Kennelly will in it recognize the Edison of old—the same master of experimental methods and lacking in none of the rare powers of interpretation to which he owed his former great achievements as an inventor. This confirmation comes at an opportune moment, for doubtless many have been misled by the gross misrepresentations of sensational newspapers to think otherwise. Reporters have taken advantage of the freedom of his laboratory, which appears to be too generously accorded, to make him pose in an unenviable attitude before the public as a miracle worker, and, to justify their stand, writing columns of "fake" matter preposterous on its face. "Edison's Wonderful Discovery"—"X-Rays Made to Penetrate Steel"—"Edison's Astounding Discovery"—"Seeing Through Eight Inches of Wood," are specimens of headlines prefacing double-leaded columns of sensational accounts, which, when not positively "faked," have their origin in the ignorance of the writers as to the real bearing of what happens to come under their eyes or to their ears. It is not necessary to dwell upon the great injustice of holding Mr. Edison responsible for this sensationalism, or confounding him with those, even of some reputation, who actually resort to such methods in order to obtain a popular notoriety which is a poor substitute for the good opinion of those in their own ranks.

THE GENERAL ELECTRIC-WESTINGHOUSE PATENT POOL.

As will be seen in another column, the General Electric and Westinghouse Companies have finally entered into an arrangement with respect to the common use of patents, thereby bringing to a close the enormously expensive litigation in which for the past five years or more those two interests have been involved. According to the official statements, the arrangement only extends to the mutual use of all patents held by the two companies, with the exception of those covering the Edison underground distribution system and the conduit railway system, presumably that employed on Lenox Avenue. Whether the Westinghouse electromagnetic system is also included in the exceptions cannot be learned. In an interview, President Coffin has stated that doubtless a scale of prices will be agreed upon which "will benefit customers of the companies and also the companies themselves," but, he added, "there is no intention of establishing high prices for electrical apparatus and supplies." From this it is evident that if, as stated, competition between the two companies will continue, the public can only profit between limits agreed upon. It is indeed difficult to see how there can be any real competition under the circumstances. As far as the interests of the public itself are concerned, however, it is probable that no great apprehension need be feared, even should the combination not feel inclined to adhere to the policy of fair prices. Electric traction and transmission of power are the only two branches remaining covered by fundamental patents, and therefore the only ones over which the arrangement gives control. Electric traction has been so fully adopted in highly profitable fields that the remaining opportunities for its extension are not, as a rule, such as would attract capital in the face of any onerous conditions imposed by the combination. While electric power transmission is just commencing its development, the past has shown that its extension requires "nursing," and any serious advances in prices would merely act to stop further growth. There are, of course, some detail patents on apparatus already installed whose strict observance may now be enforced, but many details of these escape the terms of contributory infringement. The vital matter at issue is the bearing that will be adopted toward manufacturers now in the field who may be claimed to infringe patents of the combination. There are two cases that may be considered in this connection. One refers to those who manufacture apparatus that may fairly be considered to come under adjudicated patents in the pool, or under patents now in course of litigation whose validity rests upon reasonable grounds. For the sake of the electrical industry as a whole, it is most sincerely to be hoped that some agreement may be arrived at with respect to these instances, and the deplorable condition thus avoided which was brought about by the policy adopted with respect to the incandescent lamp—a condition, moreover, which was not less injurious to the owners of the lamp patent itself than to the incandescent lamp industry as a whole. The adoption of a policy which does not regard those already in the field will in all probability result in arraying the entire independent electrical industry as well as the public, against the combination, and give rise to litigation that may be as expensive as that just escaped. The second case refers to the hundreds of patents doubtless held by the two companies which, though entirely worthless, might yet be used to intimidate small manufacturers and supply dealers. Several years ago, when an attempt was made to use such "paper patents" in this manner, the antagonisms aroused soon showed the impolicy of that course, and it was abandoned. Happily, there is every reason to believe that the broader policy which may reasonably be expected to obtain under the proposed management of the patents, will not countenance the adoption of such an unworthy and exasperating expedient.

Electric Arc Phenomena.

Prof. Silvanus P. Thompson, says the London *Electrician*, advanced an ingenious hypothesis at the Physical Society in regard to the cause of the lag of apparent resistance and of current in an alternating arc behind the phase of impressed potential difference. The existence of this lag, he said, pointed to a phenomenon "in the nature of a back E. M. F."; and it will be remembered that some time ago Prof. Ayrton showed that this apparent back E. M. F. resembled that of the self-induction of a coil when an alternating potential difference is impressed on its terminals. The cause of this much-debated phenomenon Prof. Thompson now sought in a probable lag of temperature of the carbon behind the current. It does indeed seem reasonable, says our contemporary, that a "thermal fly-wheel" action of the carbon should throw the phase of temperature behind the phase of current. Nor is it altogether improbable that the element of non-ohmic or elastic resistance in the total apparent resistance is due to a directly thermo-electric phenomenon. There should, however, be no lag between the phase of temperature and the phase of intrinsic brilliancy, and Prof. Thompson's hypothesis might be put to an exact test by seeing whether a back E. M. F. in step with the intrinsic brilliancy would be sufficient to account for the observed facts. On the other hand, it is just possible that something may happen in the alternating arc—where things occur which nowhere else occur—to throw the back E. M. F. out of phase with the intrinsic brilliancy as photometered. It might, for example, be in phase with the intrinsic brilliancy of the second, third or *n*th stratum of carbon molecules beneath the surface of the crater—an awkward place to probe with a photometer.

Nomenclature Again.

No more has been heard of the euphonious word electrosciography, but inventors desirous of immortalizing themselves seem to find it much easier work to invent new names for the Röntgen ray pictures than to explain the nature of the process. Capt. Abney's favorite is electrography. Our contemporary *Photography* wants the word to be Röntgraphy. Our objection is that if Prof. Röntgen's name is to come into the word, it might as well be spelled properly. Another proposal is radiography. None of these seem particularly happy suggestions. Some, however, of the American electrical papers have taken to calling the prints "cathodograms." That is just one thing that they are not. With the aid of a Greek lexicon it would be possible to go much better than any of these—if it were worth while. Other gems are "shadowgram" and "penetraliography."—*London Electrical Engineer.*

General Electric-Westinghouse Deal.

The directors of the General Electric and Westinghouse Electric & Manufacturing Companies on Thursday, March 12, ratified an arrangement whereby the patents owned by the two companies, with certain exceptions, will be pooled, and providing that any patent of one company may be used by the other. This arrangement, which was signed by officials of the companies, March 7, is said to have been brought about by J. Pierpont Morgan. The statement given out jointly by the two companies is to the effect that after certain exclusions, the patents of the General Electric Company contributed to the pool shall be valued at 62½ per cent., and those of the Westinghouse Company at 37½ per cent. of the value of the combined patents, and that each company is licensed to use the patents of the other company except as to the matter excluded, each paying a rental for any use of combined patents in excess of its contribution to the pool. The patents are to be managed by a Board of Control, consisting of five members, two appointed by each of the companies and a fifth selected by the four thus appointed. It is expected, the statement says, that the economies to be thereby effected will be very considerable, and that the two companies will be mutually protected.

The special incentives which led to the arrangement at this time were the recent decisions in favor of patents of the General Electric Company controlling the electric railway overhead system, and the equally strong position of the Westinghouse Company with respect to the Tesla patents, as well as pending suits relating to other fundamental patents now in active litigation.

President Coffin of the General Electric Company said that although the statement which has been given out does not happen to say so in so many words, the arrangement between the two companies has been formally approved by the directors of both companies. The agreement, he said, is as yet in skeleton form and will require several weeks to complete, but he believes it will be perfected and put into effect by June 1st. The intention is that the agreement is to continue during the life of the patents of the companies. The patents that are excluded are foreign patents and patents on cable and underground railway devices which are covered by licenses. Mr. Coffin added that no monopoly of the electrical business will be created by the arrangement and the two companies do not consolidate, but retain their entire independence and will, in fact, as heretofore be competitors in business. Prices, he said, will doubtless be agreed upon which will benefit customers of the companies and also the companies themselves, but there is no intention of establishing high prices for electrical apparatus and supplies.

A representative of the Westinghouse Company has made a statement to the effect that the management of the two companies will remain entirely distinct and separate, and that the agreement relates only to the matter of patents, the object being to end the tiresome and costly litigation between the two companies Each company is free to seek and bid for new business as it may see fit, subject, of course, to royalties and agreement. There is no intention, he said, of limiting the operations of either company to any fixed proportion of those done by the other.

The stock of the General Electric Company, which was selling at 25 a month ago, and which advanced above 30 on a report that the company had secured a contract for equipping the Mahattan Railway, touched 38½ upon the news of the deal and closed at 37¼. It is reported that those who had inside information were enabled to reap a rich harvest from the advance of the stock.

Messrs. Duer, Strong & Jarvis, of 50 Wall Street, have advertised for stockholders of the General Electric Company who are not satisfied with the management of the present company to confer with them. It is reported that the action is instituted by stockholders of the old Edison General Electric Company.

The National Electric Light Convention.

The New England Passenger Association has granted a rate of a fare and one third, on the certificate plan, from all points in their territory to New York and return, for all delegates and representatives attending the nineteenth convention of the National Electric Light Association, to be held in New York City, May 5, 6 and 7.

A Severe Test for Röntgen Rays.

The real test of this new photographic process will come when they try it on shad.—*Chicago Tribune.*

International Electric Railway Prize Problem.

The president of the commission in charge of the design and construction of the mountain railway in Switzerland to the top of the snow-clad Jungfrau Mountain has requested us to publish the following information concerning the prizes offered for the solution of certain problems involved in the construction of this road.

The total sum of the prize offered is 30,000 francs ($6000) for the best solution of a number of questions which are involved in the construction and operation of this road. The chief points involved are the following:

First: In the laying out of the road; the profile of the tunnel; the roadbed and elevated structures; the rails, rack, switches and crossings. The best system for transmitting the electrical energy; protection against interruption by atmospheric conditions; rolling stock; project for the construction of the station and restaurant at the Eiger Glacier station; design of the station (presumably near the top), which is to be bored out of the solid rock; an elevator of a height of 100 m and 8 m in diameter, to the top of the mountain.

Second: In the construction of the road, methods of boring the tunnel, and all problems connected therewith.

Third: In the operation of the road, precautions and devices for assuring continuous operation, and preventing interruptions. Methods of lighting and heating the tunnels, cars and stations.

Solutions of one or more of these questions may be offered by single individuals or by several collectively; solutions of other questions not enumerated, which are deemed of importance in the construction of his road, will also be accepted. The Scientific Commission will decide on the value of the answers, and their results will be published. By offering the prizes the company reserves the right to adopt the solutions for which prizes are offered, without further cost, on this road only; solutions which do not receive prizes will be returned.

The following information is added: The maximum grade is 25 per cent., the gauge 1 metre, the smallest radius 100 metres, the smallest "ausrundungsradius" 500 metres, the greatest width of rolling stock 2.50 metres, and the greatest height 3 metres, the allowable speed 7 to 10 kilometres per hour. The water-power for generating the current amounts to about 5000 horse-power, and will be taken from the two Luetchinen; from the turbine to the beginning of the road the distance is about 8 kilometres, and from there to the beginning of the tunnel, 2.5 kilometres; the tunnel has a length of 10 kilometres.

Applicants for prizes should send drawings or models, if necessary, as also estimates of cost. Prizes will be received up to the first of August, 1896. Further information may be obtained from the Bureau der Jungfraubahn, Bahnhofstrasse 10, Zurich, Switzerland.

Niagara Falls Water-Power.

The New York *Tribune* of March 16 devotes considerable space to the subject of diversion of water from above Niagara Falls for power purposes. It states that a bill now before the Legislature to legislate out of office the commissioners of the State Reservation of Niagara Falls has for its object to place the authority to grant permission to use water in the hands of other officials who will be more lenient in its exercise. It refers to the bill authorizing the Niagara Falls Hydraulic Power & Manufacturing Company to divert sufficient water to develop 200,000 horse-power, and quotes an opinion of Attorney-General Hancock against the grant of such a privilege. In a report of the Niagara commissioners to the Legislature it is stated that the Ontario authorities receive a substantial annual rental for rights and privileges on the Canadian side of the river similar to those granted by the New York Legislature for no pecuniary compensation whatever.

Prof. Röntgen a Baron.

Prince Ludwig, of Bavaria, on March 10, created Prof. Röntgen a baron. But a few weeks ago the German emperor decorated the Wurzburg savant with the Order of the Royal Crown,

Death from a Faulty Transformer.

At the inquest over the death of W. S. Goff, who, as recently noted in our columns, was killed by electric shock at Woburn, Mass., it was shown that the death was due to a contact between the primary and secondary of a transformer. In this case a ground necessarily existed also on the line.

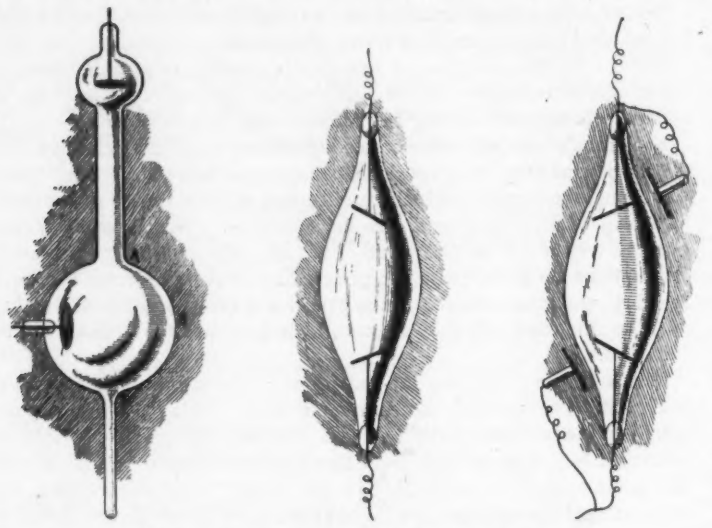
Edison's Röntgen Rays Experiments.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

Mr. Thomas A. Edison, after numerous experiments on the Röntgen rays with about 150 different glass vacuum tubes, has communicated the following information to us for publication :

First. There is no apparent advantage in obtaining a very high vacuum in the Crookes tubes employed for obtaining shadowgraphs of metal gratings. The effect of a very high vacuum is to require a greater voltage to produce fluorescence. The best degree of vacuum seems to be that at which the internal luminescence or striæ in the tube just disappear and fluorescence of the walls remains. The Röntgen rays are still produced even when internal striæ are observed, but are then much enfeebled.

Second. Thin walls are preferable to thick walls in the glass vacuum tubes. A thick wall will fluoresce more noticeably and become very hot. A thin wall will emit rays upon the photographic plate, but may scarcely fluoresce visibly and will remain very cool. This is proved by a number of experiments, of which the following is one : The tube of a shape roughly indicated in Fig. 1 has its



Figs. 1, 2 and 3.—Forms of Ray Lamps.

walls blown thick in the zone of *A C*, but thin at *B*. When this tube is exhausted and excited, the thin part, *B*, which is in the most active area, remains cool and the radiographic power is active, while the glass becomes hot in the ring *A C*. If B be made thick and *A C* thin, the glass at *B* may become melted by the heat, but its effect on a photographic plate is reduced, although its visible fluorescence is greater. Walls one eighth of an inch thick become unmanageable by excessive heating and rapid melting.

Third. For any given tube in a given condition of exhaustion, the radiographic power of the tube, *i. e.*, the swiftness with which is produced a developable image, is roughly proportional to the square of the fluorescent candle-power or total visible fluorescent light given out by the tube.

Fourth. The duration of exposure has been found to be as follows: With the most sensitive plates in an ordinary plate-holder having a vulcanized fibre light-tight cover of about $\frac{1}{32}$ of an inch in thickness, the time necessary for obtaining a good radiograph of a metal grating or grid is less than one second, when the tube is within $\frac{1}{4}$ of an inch of the grating and about $\frac{1}{16}''$ from the sensitive plate. At two feet distance, the time for an equally good radiograph is approximately 150 seconds, and at three feet, 450 seconds. For rough purposes the duration of exposure may be reckoned as proportional to the square of the distance.

Fifth: Of the photographic plates as ordinarily employed for photographic purposes, the medium rapid plates appear to be the most suitable for Röntgen rays; *i. e.*, to require less duration of exposure. Rapid plates and slow plates appear to be equally unfavorable in regard to sensitiveness for Röntgen rays as compared with medium plates. To test this, a composite sensitive plate was made from five strips cut from plates of different photographic sensitiveness, and a radiograph of a series of metal bars was taken, with the bars at right angles to the strips of the composite plate. For the same exposure and same development, the definition of the radiograph produced did not bear any apparent relation to the photographic sensibilities of the strips according to their sensitometer numbers. The medium rapid plate gave, however, much the densest image in every such experiment.

Sixth: The power of a tube having a given degree of exhaustion and disposition of electrodes increases with the surface area of its fluorescent walls; thus, a large vacuum tube exposing a large total fluorescent surface has a more rapid action on the sensitive plate; *i. e.*, requires less exposure, but will require more voltage and more electric power to excite. On the other hand, for a given distance of the tube from the plate, the image is sharper and less distorted as the tube diminishes in size. Consequently, for a given tube used without a diaphragm, long distance and long exposure produce the sharpest radiograph. A small tube will produce a sharp image at a lesser distance, and for rapid exposures a very small tube at a very short distance is the best. The smallest tubes experimented with have been about one inch in diameter, with about two inches between electrodes, and with thin glass walls. A small tube requires a small E. M. F., so that tubes can be made to suit almost any induction coil.

Seventh. For a given thickness of glass wall, German glass appears to give better results than lead glass. The German glass employed gives a yellowish fluorescence, while lead glass gives a greenish fluorescence. These glasses phosphoresce visibly for at least ten minutes after the cessation of the discharge through the tube. A particular quality of Scotch boiler water-gauge glass used gives apparently equally good radiographic results, but does not appreciably phosphoresce after the cessation of the current. The residual phosphorescence has not yet been found to produce a visible photographic image. All phosphorescence yet observed is pale white, whatever the color of the preceding fluorescence under excitation.

Eighth. The form of the tube arrived at by a gradual process of selection is shown in Fig. 2. The length is about three times the diameter. This tube is made in various sizes. When the glass walls are thin for producing the best radiographic effect, a spark is apt to pierce the wall and destroy the vacuum. Partly on this account, tinfoil caps are placed over the extremities of the tube, as indicated by the shaded areas in the sketch. These tinfoil caps are in connection with the electrodes, and are cemented to the external surface of the tube by shellac.

Ninth. It was found in numerous trials with many tubes that the fluorescent and radiographic power of all the tubes without caps was greatly increased, roughly doubled, in fact, by bringing two metallic discs, connected with the respective electrodes, to the opposite points, represented in Fig. 3. The supposition is that the tube thus becomes at once an ordinary and electrodeless tube combined. The metal caps above mentioned were the outcome of these experiments, and not only have all these capped tubes remained unperforated, but their fluorescent and radiographic powers have been enhanced by the caps. The caps serve three purposes : (a) To stop piercing by permitting excessive sparking to escape over the external surface. (b) To increase the radiographic and fluorescent power. (c) To prevent undue heating of the internal electrodes, and a consequent charge of vacuum.

Tenth. The exciting apparatus consists of a large Ruhmkorff coil capable of giving a 12-inch spark, although such a length of spark is rarely required. The coil is excited either from a storage battery through an interrupter, or preferably from a 120-volt continuous-current circuit, through a bank of from 8 to 20 16-cp incandescent lamps arranged in parallel, with a rapidly rotating wheel-interrupter driven by a small motor. About 400 interruptions are made per second, and the duration of closure in the circuit is twice that of opening. An air-blast is directed upon the spark over the periphery of the interrupting wheel through a fine nozzle. This tends to produce a sudden breaking of the circuit. It has been found that greatly improved results have followed the removal of the usual condenser and the substitution of the air-blast. The resulting secondary E. M. F. is almost symmetrical, like an alternating E. M. F., and the two electrodes are apparently equally active. The secondary terminals of the induction coil are led directly to the vacuum tube. If the air-blast is removed and the condenser substituted, the fluorescent and radiographic power of the tube is greatly diminished.

We believe that these observations of Mr. Edison cannot fail to be valuable to many practical workers with Röntgen rays. We hope to communicate further experimental results at some future time.

"Ten-Rays."

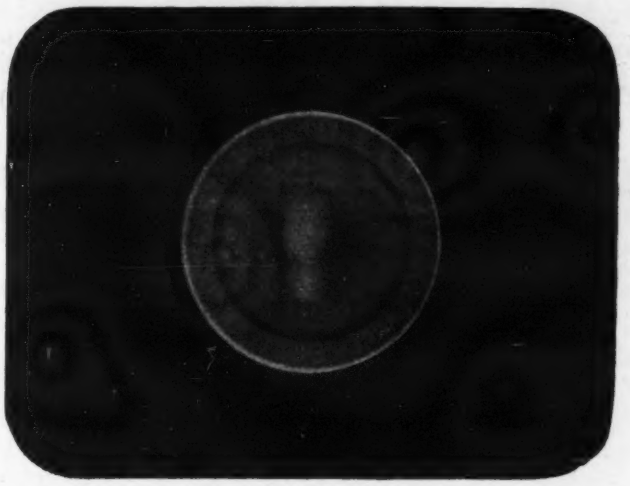
A lady who knows still less about algebra than about Roman numerals, recently asked us something about those wonderful "ten-rays."

Röntgen Rays Experiments.

BY DAYTON C. MILLER.

Experiments with Röntgen rays have been carried on very persistently at the Case School of Applied Science for several weeks, and some very interesting results have been obtained. The main object has been to secure good photographs of the human skeleton in a living subject, and to increase the practical efficiency of the apparatus. The accompanying photograph of an aluminum medal will indicate the degree of success obtained.

A hand and forearm was photographed with an exposure of 20 minutes, while the medal required but five minutes. The Crookes tube used is of the well-known spherical form, having four elec-



RADIOGRAPH OF ALUMINUM MEDAL.

trodes, designed to show that the discharge in a high vacuum is independent of the anode, and is one of a set which was exhibited at the World's Fair. It was excited by an induction coil giving about a six-inch spark in air, when using a current of three amperes and 20 volts obtained from 11 cells of storage battery. The arm was held by bandages to the plate-holder, which was supported in an inclined position upon a special stand. The usual plate-holder slide of hard pasteboard was between the hand and plate. The tube was placed at a distance of 12 inches above the wrist. Rapid plates were used and developed in the usual way with eikonogen and hydrochinon developer. A photograph showing the bones of the fingers has been made with 10 seconds' exposure, the tube being at a distance of two inches. Of course, the outlines are not as well defined as when the tube is farther away.

Bullets have been clearly located in the hands of two men with exposures of eight minutes. The first one found had been carried for over fourteen years, and was thought to lie between the bones of the forearm. A single negative disproved this, while two photographs of the hand plainly located the ball at the base of the little finger. In the second case the bullet was received in the back of the hand last August, and five negatives, taken with the hand in various positions, all plainly located the ball at the base of the thumb.

The bones of the elbow joint and upper part of the arm, and of the foot, have been photographed with exposures varying from five to thirty minutes. Longer exposures do not give better results. Some of the negatives made clearly show the ligaments connecting the bones at the joints, while none have so far shown any blood vessels or nerves.

Besides the above, a number of other surgical cases have been satisfactorily examined. Among these were the determination of injuries done to the fingers by a planing machine, the extent of diseases of the bones of the hand, and the examination of a number of fractures of the bones of the forearm to ascertain the nature of the fracture, and whether the bones were properly set.

A most interesting study has been the position of the various small bones of the wrist in different positions of the hand.

Many interesting points are noted in the work, which are suggestive in a theoretical way, details of which are not ready for publication. As already announced by Prof. Rowland, it appears that the anode is as important in the matter as the cathode. We have a number of tubes which give results, but none better than the one mentioned, while a tube just received, of American manufacture, promises to equal the imported ones.

The success so far obtained with the arm and foot encourage us to think that still thicker portions of the human body may be studied advantageously, and experiments will be immediately undertaken in this direction.

[The radiograph of the hand and forearm above referred to, which is very distinct in its outlines, has not been engraved owing to the unsatisfactory reproduction by the half-tone process of the delicate shadings of radiographs.—ED.]

Röntgen Rays.

The possibility of direct-vision radiography has for the past week been exploited in a sensational manner by the newspaper press. The invention of the apparatus for this purpose, the so-called "cryptoscope," is claimed by Prof. Salvione, of Rome, but, as pointed out by the London *Electrical Review*, this method was really used by Röntgen in his earliest experiments. Mr. Swinton, of England, has been making some successful experiments in this direction, which are reported in the English electrical journals of March 6. He soaks a piece of blotting paper in a solution of barium platino-cyanide and places it inside a tube at the back of a sheet of opaque paper covering the end. The eye placed at the aperture at the other end of the tube can see a shadow of the object on the fluorescent paper.

Prof. Pupin has had no difficulty in seeing through solid bodies with the aid of such a screen. In an interview with the New York *Journal*, he states that it is easy to look through the bones of the hands, and when the light is just right even some of the muscles may be seen on the screen and traced throughout their length.

Mr. Edison used a disposition somewhat different from the above. He encloses very small crystals of platino-cyanide of barium between two plates of mica and secures this fluorescent screen at the bottom of a pasteboard box about 6 inches square and 7 inches deep. In extremely sensational accounts of his experiments in this line which have appeared in the daily press, it appears that a shadow may be seen on the screen when an object is passed between it and the source of Röntgen rays, though opaque substances are interposed between the object and the screen, but the outlines of the shadow are not well defined.

RADIOGRAPH OF PARTS OF WATCH.

Mr. Albert Sauver has taken some extremely sharp radiographs in the laboratory of the Illinois Steel Company. One of these we reproduce, showing the different parts of a watch. The sensitive plate was covered with a sheel of black paper placed in a cardboard box and the latter enclosed in another similar box. Quick plates were used, the exposure being about one and one half hours. The current was derived from a three-cell storage battery and an induction coil giving a three-inch spark was employed. The distance of the tube from the plate was five inches.

Among some recent radiographs taken in the Shallenberger laboratory is one of a human embryo, which illustrates in a striking manner the extent of the service which Röntgen rays will render to science. In this instance the stage of bone development is clearly indicated; some parts of the skeleton structure are shown to have neared their final shape, while others are as yet only partly developed. The growth of bone would appear to commence near the middle of the final length, the ends being formed last. Another radiograph taken by Mr. Herbert W. Shallenberger is of the head and neck of a fowl, in which the gullet is sharply outlined, showing that its substance is more opaque to rays than the surrounding flesh.

The Two-Phase Transmission Plant at Springfield, Mass.

Six and one half miles from Springfield, at Indian Orchard, a water-power is utilized to increase the capacity of the local lighting company's plant at Springfield. While not of such general interest as some of the longer and larger transmissions of power, yet the installation has certain distinctive features, some of which are pertinent object lessons in the problem of transmission of power.

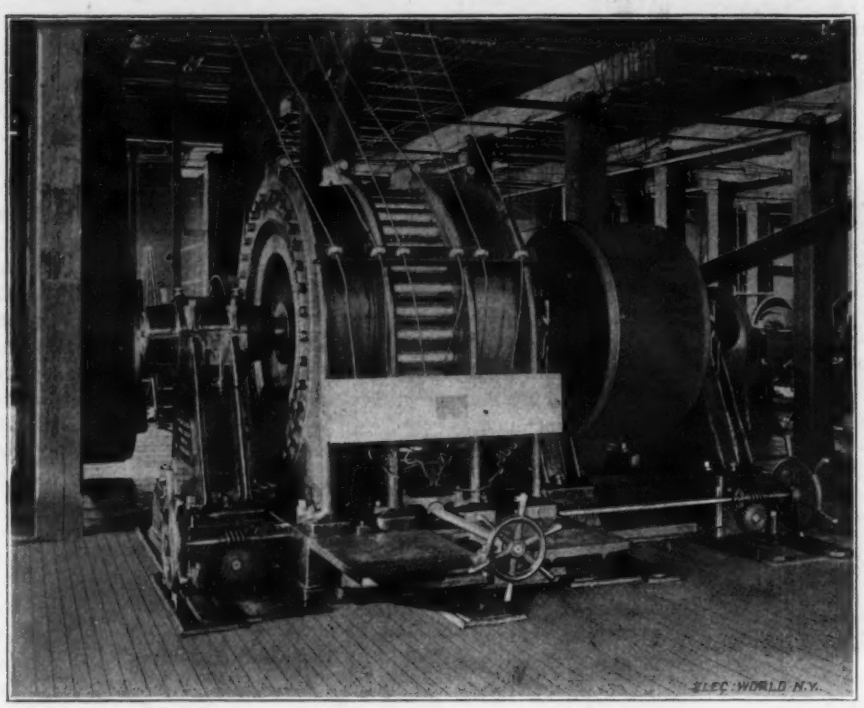


Fig. 1.—Generating Plant at Indian Orchard.

The generating machine, belt-driven from the source of power, is of the well-known Stanley-Kelly induction type. This machine, shown in Fig. 1, has a cast-steel inductor with laminated poles revolving on the shaft. Its sole function is to open and close the magnetic circuits of the machine, and, therefore, it carries no copper conductors whatever. These are embedded on polar projections in the outer frame. Being stationary they are susceptible of the highest insulation, and for this reason this type of machine is often built to deliver its output at 5000 or even 10,000 volts. This particular machine yields current at a voltage of 3000 to 3500, the voltage varying with the load. The loss in transmission is about 12 per cent. The capacity of the machine is 250 kilowatts. It is provided with ring oiling bearings and mechanism for aligning the frame and the rotating parts.

The power is transmitted by four wires. The two-phase system with independent circuits is used, and to avoid mutual induction on the line the circuits are on diagonals of a square 12 inches on a side. On the way to the station of the Springfield Lighting Company, the wires are tapped to supply a two-phase induction motor with an available output of 30 horse-power. Continuing on to the station, the high-pressure wires go directly to a synchronous two-phase motor of precisely the same type as the machine at Indian Orchard. This machine is shown in Fig. 2. The machine is not self-starting, but is brought up to synchronism by the jack shaft to which it is belted. The current is then turned on and the machine takes power from the line and delivers it to the jack shaft. As no transformers are used, their efficiency does not lower the efficiency of the transmission. This is a valuable feature, and is only possible with machines which can successfully generate and receive current at high voltages.

The induction drop on the line is of some amount and it is met in a way that is rather a departure from present practice. A bank of nine condensers, so connected that their combined capacity may be readily varied, completely controls the lag. In addition, the fields of the synchronous motor may be over-excited and thus the induction drop may be completely eliminated. The practical performance of a condenser has always been a matter that has been looked upon with considerable scepticism. Their discharge is always liable to produce resonant oscillations which puncture the insulating sheets. In this case this trouble was experienced and avoided by ingeniously inserting carbon resistances in circuit at the moments of opening and closing, which device has proved a complete cure for the difficulty. There are but two motors on the line and these absorb all the power; no lights are run on the two-phase circuits. The frequency is 133 periods per second. The idea of the lighting company in adopting two-phase transmission was simply to have an economical, flexible system of obtaining the power at Indian Orchard to add to the output of their station. It is not proposed to make their whole light and power system two-phase.

A little reflection will show the extreme flexibility of the system just described. Being provided with transformers to transform the two-phase voltages to those suited for commercial practice, the station can receive the current from the line and send it out to supply lighting circuits and supplement it with the output of the synchronous motor run as a generator. In case of a break-down of one of the other sources of supply in the station, this might save the destructive consequences of a shut-down. This change just indicated can be effected by the mere throwing of switches. It remains to be stated that the machines have always worked perfectly, although they have seen almost absolutely continuous service since the day of their installation. The installation is interesting in that it conclusively shows that small water-powers may be used to advantage for such purposes and the establishment of this fact may solve many vexatious problems.

A small water-power, while very desirable, might not be of sufficient magnitude to warrant the location of a large steam plant upon its site By this simple and economical method the power is utilized, and the difficulties of water-wheel regulation and the co-working of steam and water-power are done away with. The site of the station is independent, and the transmission, employing no transformers, is of high efficiency.

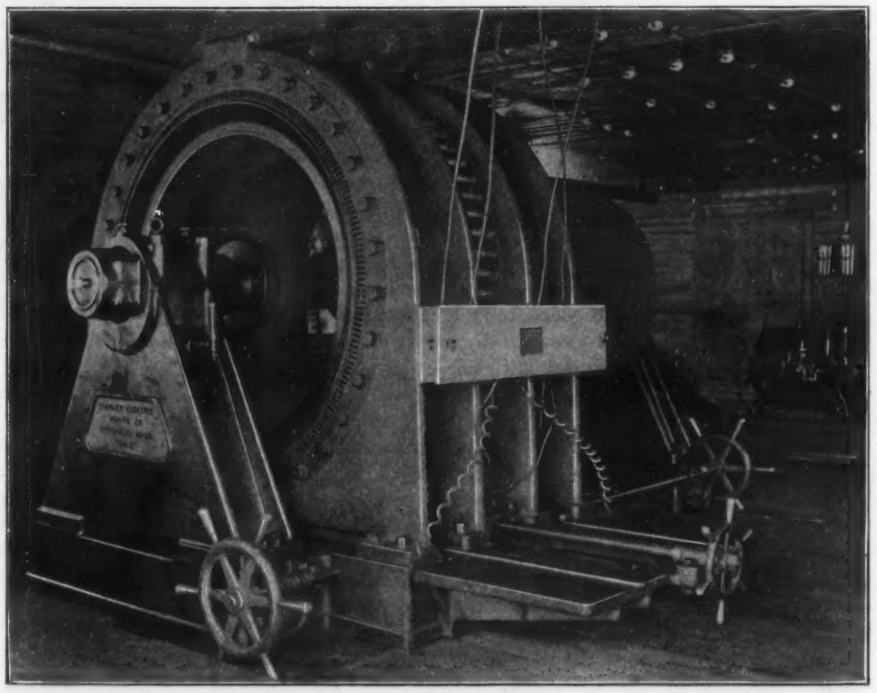


Fig. 2.—Synchronous Motor at Springfield.

Oil as an Insulation.

"We do not think," says the London *Electrician*, "that oil insulation is going to play a great part in the future."

Central Station Working—XII.

A FEW SUGGESTIONS TO STATION OWNERS AS TO THE SELECTION OF TRANSFORMERS.

BY R. E. RICHARDSON.

YEARS ago the experienced central-station manager began to realize that, if he wished to reduce the size of his fuel bill, and generally reduce the operating expenses, and increase the income from his plant, he could do so by simply replacing the small transformers with larger units, and bunching his secondaries. It is evident that in the case of store, factory lighting, etc., lighting in a business portion of a town or city, or in a very thickly populated town, large units in transformers can be used to a much better advantage than in the case of widely distributed residence lighting, as the cost of copper or loss incurred in the secondaries in attempting to use large central units, in the latter case, would ordinarily be more than the extra loss by leakage due to the use of a number of small transformers. While the above statements are and have been well known and recognized for years, and it is but a simple example in addition and subtraction to prove the case, it is a fact that many station men either do not know or fail to appreciate its importance in selecting their units and laying out their lines. It is very evident, as above stated, that in the case of large central stations, whose principal load comes from store, hotel, factory and office building lighting, large units can be more economically used, and they are most naturally selected; but in the case of small stations in towns from 1000 inhabitants upward by making a careful study or examination one large transformer can often be centrally located or made to replace from five to ten small ones. None more fully recognize the increased economy in using large units than the manufacturers of transformers, and if one will only look through his price lists of to-day and compare them with the price lists of a few years ago, he will find that in a number of cases the 5 and 10-lighter has entirely disappeared from the list.

A short time ago the writer's attention was called to two plants, both of some 3000-light transformer capacity; the largest transformer in use on one plant being a 30-lighter, the bulk of the units being 5 and 10-lighters. Fuel at this place was high. Taking the loss in leakage and working it back to the coal pile, and then putting larger units in place of his present transformers, thus decreasing his leakage (the local conditions being highly favorable to large units), the saving in coal alone by this change would, in a little over a year, pay for the entire new equipment of transformers, assuming that the old ones were thrown on the scrap heap.

In the case of the other plant, the owner came into our office to see about getting some new station machinery, as his present plant was loaded to its limit. Upon investigation, it was found that by putting in new transformers, instead of a new engine and dynamo, he would reduce his loss due to leakage to such an extent that not only would his present station apparatus not be overloaded, but he could even connect more lamps to his present lighting plant. The same conditions can be found to a greater or less degree throughout the country.

To be sure, considerable attention is now being paid to this point, but in most cases where plants were installed three or more years ago, it will well repay the owner of the plant to carefully and thoroughly look into this question. Where fuel is very cheap or water-power is used, it is of course not as important an item, but the station man must not forget that even under these conditions, the capacity of his dynamo for turning out lights, in other words, the possible earning capacity of his plant, is decreased in direct proportion to his leakage losses. As a further evidence that the evil practice of using small transformers has not disappeared, only last week the writer saw an order for transformers for a new plant, there being some 800-light capacity ordered; the order reading for two 20-lighters and the balance in 5 and 10-light transformers. It would be but pertinent to add, that where this plant is to be located, a fair grade of mine-run coal costs but $4 per ton. As the efficiency and regulation of a transformer are interdependent, and the leakage current determines the efficiency, the station operator should most carefully take into consideration both sides of the question and try to select those transformers which will give to him the minimum leakage current without sacrificing his regulation to such an extent as to give poor service to his customers, or unduly shorten the life of his lamps. In most cases where a plant is not operating as economically as its owner figures it ought to, the fuel bills being too big, etc., he immediately thinks of trying a new heater, changing his boiler settings, having his engine valves reset, etc., all of which are most sensible proceedings. But why does he almost invariably forget another possible, yes, probable source of loss, which will be found, not inside of the engine or boiler room, but on his lines and often in his transformers.

It is a common thing to hear a station manager say: "My transformers are all right; have had them in use for some eight or ten years and very rarely have a burn-out or any trouble; and if we do, we repair them at the station." If that plant is on a paying basis, it is not necessarily through any "fault" of his; and if his power costs anything, he could materially increase the earning of the company by *one* change, viz.: to promptly replace those old transformers with ones of modern make and carefully select the proper units or sizes.

Some six years ago the writer was informed by some engineers who had looked into the question of the units of central stations, that but a very small percentage of central stations operating with alternating apparatus were on a paying basis, and I also remember reading some statistics on the same general line. If the statements made at that time are true, and the statistics correct, it is the writer's belief that a larger percentage of the unnecessary losses which made the showing of the alternating plants at that time so poor, can be traced to the transformers than to any other source.

If you have a station with some 2000 lights wired up and can get a load of 600 to 1000 lights for several hours each evening, and do not make it pay then, while there may be some radical trouble with your individual plant, you will probably find that you are the first and main cause of the defect in the plant, and that the way to correct the same will be to make a diagnosis of your plant and the outside conditions; if this is done in an intelligent way and the proper remedies are applied, the plant can be put on a paying basis.

Too often failures have been attributed to systems, etc., when the fault should have been laid directly at the door of the designer and operator of the plant. A central station with an alternating system seems to me to be like a business house with a number of employees, working for the house, the transformers being the employees of the station, and each one an expense to the station to feed and maintain. If a business house, selling boots, shoes, dry goods, groceries, or carrying on any other similar line of business, could cut down the number of the employees which it has to support, increasing the salary of those retained a little, so that the total amount of salary increase would be nowhere nearly as great as the salaries of the dismissed employees, and yet get the same amount of work done, would not this be the natural course for a good business house to pursue? It must not be forgotten that a central station is a business house, not selling and delivering boots and shoes, dry goods and groceries, but electricity, and that it must be run on the same business principles and with the same business precaution that is taken in other lines of business.

Electricity in a Paper Mill.

A new field is opening up for electricity through the introduction into paper mills of electric motors to run paper machines, to which use they are particularly applicable on account of the requirement of steadiness of speed, being in this respect much more satisfactory than steam power. Such an application is about to be made at Niagara Falls, while a similar one is contemplated at Watertown, N. Y.

The Cliff Paper Company, of Niagara Falls, will shortly drive their two paper machines by electricity. The water used to run the paper mill on the high bank passes from the turbine wheels there to penstocks and runs a pulp mill at the bottom of the gorge. A stone electrical power-house 20 x 30 feet has been erected between the lower mill and the bank, it being situated so as to be completely hidden from view except when looking directly down upon it. Here the company will put in a 250-hp Leffel turbine of the horizontal type. Two electric generators of 100 kw each will be direct-coupled to the turbine shaft, one on each side of the wheel. The contract for these generators has been given to the Card Electric Company, of Mansfield, O., and are now being built on special designs and patterns; they will be something new in their way, and are guaranteed to produce a current of great steadiness. The contracts for two motors of 100 horse power each have been given to the American Engine Company, of Bound Brook, N. J., which company is now at work on them. The contracts include the necessary switchboards, wiring and accompanying apparatus. The several companies have guaran-

teed their machinery, except the commutator, for five years. It is designed to attach a motor to each machine. It is estimated that the electrical equipment together with the wheel and power-house will cost $10,000. All that the Cliff Paper Company will have to do is to tap the penstock which feeds the pulp, mill wheels and build a branch penstock to the electric power-house.

Manager Hastings of the Cliff Company states that within 60 days he expects to be running the mills by electricity, which will result in curtailing expenses and cheapening the cost of production, as well as giving a better power. The water-power, he said, does not cost more than $10 per yearly horse-power on the shaft for a 24-hour service, which price, he believes, cannot be duplicated the world over. He has secured the cost per horse-power of steam from several large mill owners, and finds that he can produce the same power by electricity much cheaper. Electricity, he believes, is the coming force for paper mills in the near future. Electrical apparatus, he found, can be purchased 50 per cent. cheaper to-day than 18 months ago. As many as a dozen firms submitted figures for the electrical machinery, and he found that it can be purchased 50 per cent. cheaper to-day than 18 months ago. The electric power will be more convenient, for when a mill is using power from one wheel, if anything breaks on a machine the whole mill has to be shut down, while the electric current can be cut off anywhere and the rest of the mill continued in operation. The introduction of electricity in the mill will throw out three steam engines of 225 horse-power combined.

The turbine is of the double-discharge type, 23 inches in diameter and of 300 horse-power with a full gate working under a 125-foot head. The wheel will run at 625 revolutions per minute, an extraordinarily high speed, calculated to secure a very uniform rate. The runner is fitted with special metal cases supplied with cast-steel balance gates. On the top is a large air-chamber to cushion the water hammer that is liable to occur in this high speed.

Each end of the turbine shaft is fitted with insulated couplings directly connected to the electric generators. The bases of these generators are finished and mounted on the same steel beams that carry the turbine. The turbine gates are of special design and connected by a suitable level with one of the latest and most improved designs of automatic speed-regulating governors. This governor is guaranteed to be efficient for close speed under any sudden change of power that may be thrown on the turbine through changes of demand for electric current.

The Cliff Paper Company, in its pulp mill running below the bank, is equipped with two Leffel double-discharge horizontal turbines, operating under the same head of 125 feet, and are of the same design as the one to be used in the new power-house. They are of larger dimensions, each developing 1200 horse-power at a speed of 215 revolutions per minute. These turbines have been in successful operation for over three years. The new turbine is now about ready to be set up.

Telephone Construction in the Rocky Mountains.

BY J. W. DICKERSON.

The Colorado Telephone Company owns and operates a connected system that furnishes communication between all important points in the heart of Colorado. The main trunk or division lies substantially north and south, as is shown in the map of the system, Fig. 1. It extends as far south as Raton in New Mexico, while the Northern terminus is Eaton, within 25 miles of the Wyoming line. Branches extend from the main trunk to all places of consequence as far west as Aspen. The company also owns a comparatively short connected system in New Mexico with Las Vegas as a centre. Isolated exchanges are maintained in several cities and towns, some of which may in time be connected with the long-distance system.

The headquarters of the company are in Denver, where the telephone building, located on Lawrence Street, is one of the most commodious, convenient and best arranged structures of the kind to be found anywhere.

Of the 664 miles of pole line owned by the company, at least 300 miles have been built in mountainous districts, and in the extensions of the system in these localities the most interesting features of its construction are to be found. The building of these mountain lines has been expensive, as many difficulties have had to be surmounted, but the great outlay has, as a rule, been justified and has been appreciated by the public. The service is liberally patronized, so liberally indeed that the existing facilities are greatly overtaxed at some points, and plans for adding new circuits and providing additional improvements of various kinds are under consideration.

During the last year the most important move executed by the company was the construction of the line from Leadville to Aspen, which, as has already been stated, is the most westerly point now reached by the long-distance system. The line was built last Summer, and for the construction almost two months were required. In an air line Leadville is located about 32 or 33 miles from Aspen, but the telephone line built over the mountains necessarily follows a somewhat circuitous route and is 48 miles in length. The poles are

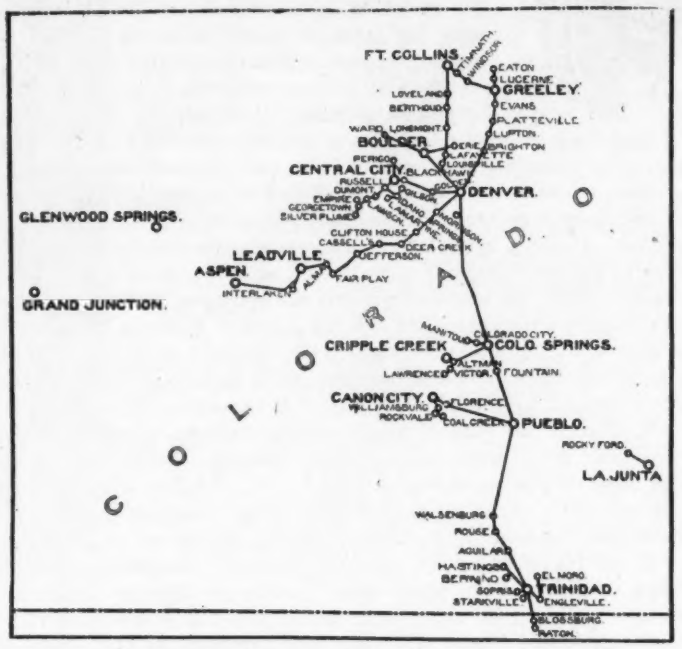


FIG. 1.—COLORADO LONG-DISTANCE TELEPHONE SYSTEM.

located along the wagon road for considerable distances, but at many points short cuts are taken, the poles being then set on grades too steep for vehicles to surmount. The line is, therefore, much shorter than the wagon road and its total length is hardly more than one third that of the railway which connects the two cities.

In the ordinary construction the poles are set 42 to the mile, but at certain points where sharp turns are necessary the number is sometimes increased to as many as 75 per mile. When timber is encountered it is necessary that a path should be cleared for a distance of 200 feet on each side of the line, in order that wires may not be broken when trees are blown over by the extraordinary gales which sometimes prevail. For this reason it is essential that the members of the construction gang should be expert choppers as well as linemen.

The preparation of the holes for the poles is a slow and fatiguing process, especially when undertaken on high altitudes. Ordinarily it is necessary to blast a place for the pole by the use of giant pow-

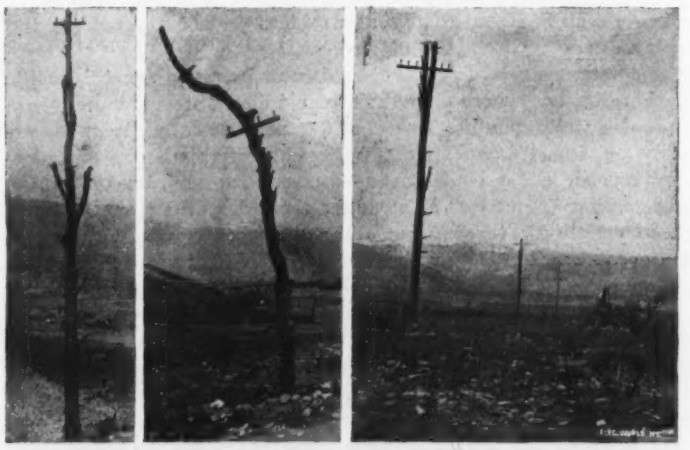


FIG. 2.—TREE-POLES.

der, and one man in the employ of the company, an ex-miner who has had an extensive experience with explosives, is especially assigned to work of this class. On the Leadville-Aspen line not less than 300 pounds of giant powder were used for this purpose. Under these conditions to dig a pole hole is often a hard day's work for an industrious man.

The difficulty of preparing lodgment for the poles is not the only cause for slowness in prosecuting construction on the mountains. Any prolonged effort in the extreme altitudes is exceedingly exhausting. At one point in the Leadville-Aspen line the wires are strung at an elevation of 12,000 feet above sea level. In such an altitude the lineman soon becomes completely tired out; and after he has climbed two or three poles he is ready for a period of rest in which to recuperate his energies.

The poles, which are native grown, are usually 25 feet high and are buried five feet. They are drawn up the mountain roads to points above those where they are to be finally placed, and are then "snaked" down by the men as they are required.

When the Continental Divide was reached on the Leadville-Aspen line poles were abandoned, and the circuit was continued by means of a cable buried in a two-foot trench for a distance of 7600 feet. The cable is of the unarmored, submarine type, and was furnished by the Standard Underground Cable Company. Fig. 3 shows part of the district in which the cable is located, workmen being shown engaged in the excavation for the trench.

The advisability of abandoning aerial construction at this point was demonstrated by the experience required by the company in maintaining the Denver & Leadville line. At Mosquito Pass, on

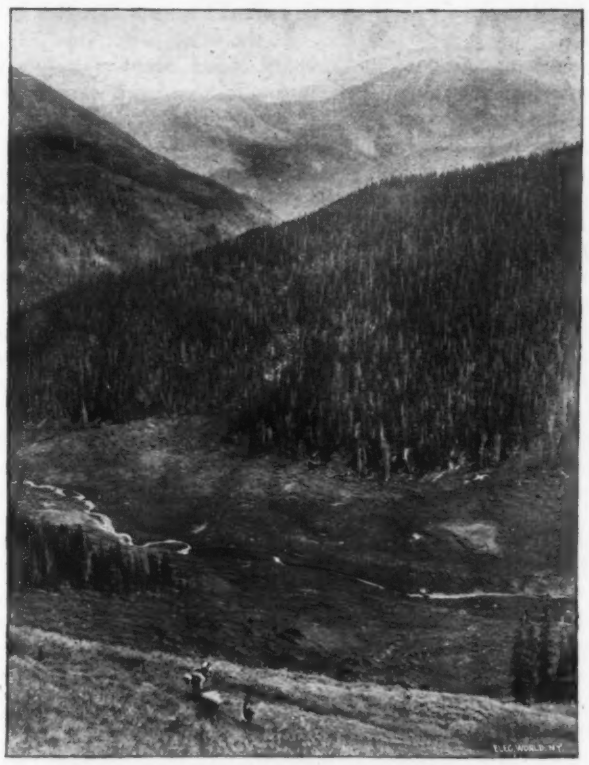


FIG. 3.—CONTINENTAL DIVIDE.

that line, the poles were originally set 100 feet apart. As soon as the wires were covered with sleet they promptly snapped, and the line was useless. Double the number of poles were then used, but the result was not different. As a further experiment poles were set every 15 feet, but the No. 6 wire failed to hold up when the sleet began to accumulate upon it. The necessity of introducing radically different construction became evident, and a Standard underground cable was used for two and a half miles. No trouble has since been experienced with the line. One is not surprised to learn that the aerial wire failed when one hears the stories of ice-accumulation on the wires from men who have had experience with mountain telephone lines. The foreman of the construction gang remarked to the writer when questioned about the difficulty: "Why, man, the sleet comes down Mosquito Pass in such a way that a telephone wire would be as big around as your body in no time."

When trouble is encountered on these mountain lines during the Winter season the linemen who are sent out to locate it and make repairs must make their journey on snowshoes. If they are overtaken by a storm or find they must remain out over night, they push on for the nearest refuge, which is ordinarily a deserted cabin formerly occupied by some prospector or miner. All the poles are numbered and the linemen are furnished with maps, showing that shelter of some kind can be found near poles of certain numbers.

The construction gang which built the line from Leadville to Aspen last Summer comprised 30 men, who camped out at night in tents, and the table was under the charge of a cook and an assistant attached to the expedition. One of the members of the party is authority for the assertion that the bill of fare was much more attractive than that encountered at any of the hotels along the line. The work was done during the months of July and August, and for the most part pleasant weather favored the progress of the work. Every night ice was formed in the creeks along the way, so that clothing warmer than that usually essential in Summer necessarily formed part of the equipment.

While tents were ordinarily occupied at night the party on one occasion enjoyed the luxury of sleeping in houses. Fourteen miles east of Aspen the gang took possession of the deserted village of Independence, a town which in 1881 boasted of a population of 1000, but which fell into decay when the stage line abandoned it. The visitors revived the memories of municipal life by holding a mock election at which a temporary mayor was elected. No ghosts haunting the deserted homes disturbed the hard-earned rest of the unimpressionable linemen.

Fig. 2 shows some curiosities in the way of poles which were once to be seen in the vicinity of Leadville, and were used by a company whose rights have been acquired by the Colorado Telephone Company. These extraordinary poles were old trees, which were used for carrying cross-arms, as they happened to grow at points where supports for wires were required. It will be seen that they were made to carry as many as 12 and 15 wires. They have now been replaced by poles of the standard pattern of the company.

An Inventor's Appeal.

The following is a photographic reproduction of a handbill received in our editorial mail which, we believe, may not be without interest to our readers. We take pleasure in giving further publicity to this touching appeal of an unappreciated inventor, partly to place ourselves on record as free of the ulterior influences ascribed to others, partly to present a typical example of the discouragement, so pathetically set forth in the handbill, which traditionally attends the footsteps of the inventor, and partly as a recognition of a persistence that some day, though perhaps in another field, may bring its reward :—

STREET LIFE SAVER!

Automatic Car Stop.

to prevent any accident on Electric or Cable Cars. It is no Fender and does not depend on a man to work it. Will stop the car within 12 inches of any object in case of accident. Invented by

M. HANKIN, Electrical & Mechanical Engineer of Brooklyn.

My object is to get the help of my fellow citizens because I can not see any way to compel the Railroad Companys to adopt it, as I have no Capital or Friends. I have tried many different ways but it was impossible to succeed in accomplishing my purpose. I went to the R. R. Co. but it had to go through many hands and they all want something in advance. I have tried the Editors of the public presses but have received only promises. I have tried the Mayor of Brooklyn but I have no pull there. I have tried many people with capital and influence but they want it all. Now I appeal to you Citizens to help me and save yourselves while crossing the Streets. I will explain to you the way of the Electric car which is in reallity an Electric Chair.

People in Brooklyn have adopted the Electric Car to ride quicker, N. Y. State has adopted the Electric Chair to kill quicker the difference is that on the Chair are killed murderers, by the Cars innocent children. The City of Brooklyn and other Cities have adopted fenders which are simply masks to hide the real danger from the people Senators have tried to pass a bill to compel the Company to use regulators of speed They have tried slow speed and put inspectors to watch, it has been tried to compell the motermen to learn how to reverse the current in case of accident but where is the improvement? It is all merely talk.

1 No Fender can be made for that purpose because said fender cannot pick up anybody from the track & no human being in case of falling could not possibly have his sense to hold on the fender until the moterman is ready to stop the car. On this subject I am ready to prove to any inventer of fenders of any make that they cannot accomplish what they claim.

2 No man can control himself in time of danger when he is the cause of it and no man can keep his eyes on the truck when his attraction is called in another direction I mean a motermen although he is not to blame

3 The R. R Co may say that it cannot be helped, but it is not so, there are many things which can be done. Motermen have instructions to reverse the car in case of danger but this method is very dangerous as it is liable to set the car in fire

4 Slow S peed don't prevent the killing part because the people while crossing cannot exactly calculate the distance and velocity of the car

5 The power of Electricity is a secret from many people. It is the developing strength of friction. The works in the car have a certain amount of Electricity after the curret is completely shut off, which makes it so much harder for a mam to control it

My experience in experimenting.—I am an Electrical Engineer by Trade, an Inventor from experimenting, I have worked for Thomas and Houston (Electric Manufacturing Co Lynn, Mass.) on their first Electric Railway now so successful, I have been a moterman for the Atlantic R. R. Co. Brooklyn, N. Y.

I have a new discoverey, on underground conducter for Railways also other very useful works which are yet secret as I wish to have benefit from them.

After my experience in experimenting I feel confident that I can stand against any inventor on any subject of works.

Do remember that in your helping me your life is at stake as well as my benefit Those that can in any way with their advise or assistance help me to gain my end and so secure and prevent the untimely death of innocent little Children will please write to me for which I will be ever grateful.

M. HANKIN 78 MYRTLE AVE., BROOKLYN.

March 2nd 1896

Governing Nature's Laws.

The City of Richmond, Va., has passed an "Ordinance to Prevent Electrolysis." This is one of the many instances on record in which attempts have been made to govern the laws of Nature by legislative enactment.

The Direct Connection of Electric Motors with Machines of Various Types.

BY WILLIAM BAXTER, JR.

Whenever we are called upon to determine the merits of any new method proposed for the accomplishment of old operations, we must view it from every standpoint in order to be able to properly decide whether its adoption would be advantageous. Not only must we consider its feasibility from a technical standpoint, but also its relative advantages and disadvantages in the way of economy of operation, durability, reliability, etc., as compared with the method it is intended to replace.

On general principles, we may say that the direct connection of an electric motor with any kind of machine is possible. The problem presents no difficulties, no matter what the conditions may be, that cannot be successfully overcome. If the mechanism is of the most delicate character, and requires the greatest accuracy of motion, or if, on the other hand, it is ponderous, and irregular in its action, it can be operated just as successfully as if it presented no unusual features, by simply adopting the motor and its controlling switch and other devices to meet the requirements of the case. But the mere fact that the motor can be made to meet the requirements in any case is not necessarily proof that the combination would be successful in the long run, or that it would have advantages over the older method of operating from a line shaft. To determine this point we must consider the advantages and disadvantages of both methods, and weigh one against the other. In this way we can ascertain whether upon the whole the connection of a motor with any particular machine would be desirable.

This subject of the direct attachment of motors to various kinds of machinery has received considerable attention within the last few years, and has many prominent advocates; some of its strongest admirers going so far as to say that all kinds of machinery should be operated in that way. That the arrangement would give very satisfactory results in many cases there can be no doubt, but that its universal application would be an improvement on present methods is not so certain.

The advantages that can be claimed for the system are, first, that it would save the power absorbed by shafting and belts. But as an offset to this saving, we would have the loss of energy in generating the electric current, and in its transmission to the motors, and the further loss in reconverting it into mechanical energy. That the former would not be the greatest in every case, will be shown further on. The second point of advantage would be that by doing away with belting a considerable source of danger and accidents would be removed.

As a further advantage we might claim that a shop so equipped would present a much neater appearance, would be cleaner, would have more light, and the atmosphere would be purer, as it would be free from particles of disintegrated belts, etc.

The loss of energy in shafting and belting is very far from being regular. If a constant ratio existed between the power utilized by the machinery and that applied to the main driving belt, it would be possible to decide, by a simple calculation, whether a higher efficiency could be obtained by the direct application of a motor to each machine; but as the conditions vary so much in different cases no such simplification of the problem can be effected. Each particular case must be considered with due regard to all the surrounding conditions. A consideration of the variation in amount of loss due to changes in the conditions will enable us to judge, at least with a fair degree of accuracy, the lines of manufacture and the kinds of machinery wherein the advantages of direct connection would be the most decided.

The desire to generalize the results of any investigation is so great, and the fascination of such methods so strong, that one is lead almost irresistibly into undertaking that course; but work expended in that line would be practically thrown away, because the conclusions arrived at would only apply to the average conditions, and would therefore be of very limited application, as nearly every case departs, either one way or the other, from the average on which the conclusions would be based. It is best, therefore, to abandon all effort to deduce conclusions of universal application, and endeavor to point out the conditions governing the attachment of motors to any type of machine.

Shafting, if properly lined and running in well-lubricated bearings, does not absorb much power, neither do belts, unless they are crossed and run at high velocities. But even cross-belts running at high velocities do not use up much power, unless the shafts they connect are very close together relatively to the size of the pulleys. These statements, which are well-known facts, would lead to the assumption, off-handed, that nothing could be gained in the way of efficiency by direct-connection of motor with the machines to be driven; but this is not necessarily so, from the fact that, small as the power required to run the shafting and belting may be, it may equal and even exceed that required for operating the machinery. If the design of the machines is such that they take up considerable space in a line parallel with the shaft, compared to the power required to operate them, the percentage of energy utilized will be small, but not so small as would appear at first sight, owing to the fact that for such purposes the shafting would be light. Sewing machines, paper-ruling machines, many types of printing presses, lathes for light metal work; drill presses, etc., are examples of machines that monopolize a considerable length of shafting as compared with the power required to drive them. Among the machines with which the conditions are normal may be mentioned grindstones, polishing wheels of all sorts, wood planes and circular saws, grinding mills, etc.

The loss of energy in operating machines by shafting cannot be determined, directly, from the power utilized per unit of length of shaft, for the simple reason that the size of shafting and belts increases and decreases with the work done per unit of length; therefore, the loss varies in accordance with the same conditions. If we had any experimental data on this subject we could make positive deductions; but not having such information, all we can do is to draw conclusions based on practical experience. Proceeding in this way, we can say that a line of shafting that delivers energy at the rate of, say, one horse-power per foot of length will not require to overcome the friction of bearings and belts 50 times as much power as a shaft that could only deliver one horse-power for every 50 feet of length. In fact, we could safely say that it would not require 10 times as much. We thus see that, while not able to give any figures that would show a positive relation as to power absorbed between light and heavy shafting, we can, without fear of making a serious mistake, say that the loss increases as the power delivered per unit of length decreases. This being the case, it is evident that the greatest gain in efficiency by the direct connection of motors with machines would be obtained when the motors are connected with light-running machinery; that is, if other considerations which affect the case are not taken account of. But we know that very small motors are not as efficient as somewhat larger machines, they are much more liable to get out of order and cost very much more in proportion to their size.

If we were to consider that the desirability of direct connection was wholly dependent upon the relation between power required and space occupied, we would conclude that the operation of sewing machines by independent motors would give much better results than those obtained by the use of shafting. These machines when placed on a table in a work room require about two feet of shafting each, and as one horse-power will drive from 20 to 30 the energy absorbed is at the rate of about one horse-power for every 50 feet on an average. But we know from experience that for this class of machines more efficient and reliable results are obtained by the use of shafting. This, however, is due to the fact that the units are so small that the motors are little more than toys. Their efficiency is very low as compared with somewhat larger machines, and the liability to get out of order very much greater, owing to the fact that all their parts are more frail. If instead of 20 or 30 sewing machines, we had one or two machines that would take up the same space, and require the same power, the case would be very different.

Then the units would be of sufficient size to enable us to use motors of fairly good efficiency and strong enough machinery to withstand the strain of constant usage without undue wear. From this we can see that the direct connection of motors with machines to be driven thereby is not advisable when the power required is very small, because then we would have to make use of motors of low efficiency and so delicate in construction that they would not stand the strain of constant use; therefore we would gain nothing in the way of power consumption and would lose considerable in cost of maintenance and reliability of operation.

It may be said that this reasoning is not sound, and that we can make small motors of very nearly as high efficiency as large ones and not much inferior in point of durability. This is very true, but the cost of production determines these questions, and this must be kept within reasonable limits; if not, the first cost might be so great

as to offset all other advantages. From what we know of the efficiency and reliability of operation and cost of maintenance of small motors, we can assume with a fair degree of accuracy that any combination involving the use of motors of less than one horse-power would not be advisable.

(To be continued.)

Notes on Accumulator Testing—IV.*

BY CARL HERING.

In conclusion a few figures may be added to show what may be expected of an accumulator. The original Planté accumulator of 1860 had a capacity of 7.25 ampere-hours per pound of plates, but the corresponding rate was unfortunately not recorded. The following are deduced from the catalogues of the best known accumulator company in this country, and show what may be expected from a good accumulator having thick masses of active material, as distinguished from one in which the action is entirely a superficial one. Cells of 100 to 350 ampere-hours at a 10-hour rate average from three to four ampere-hours per pound of cell, complete in glass jars; no figures are given for rubber jars, but it appears from some measurements that the number of ampere-hours per pound would be about 5 to 10 per cent. greater. For large cells from 1000 to 5000 ampere-hours, the number of ampere-hours per pound of plates alone is five. For a four-hour rate, the former average from 2.6 to 3.3, and the latter 4.2, that is about 20 per cent. less. Assuming a mean useful voltage of 1.95 for a 10-hour rate, and 1.90 for a four-hour rate, the capacities for the 100 to 350 ampere-hour cells are from 6 to 7.8 watt-hours per pound of cell complete in glass jar, and for the large ones 9.75 watt-hours per pound of plates alone; for a four-hour rate these figures are 5 to 6.3 for the smaller, and 8.0 for the larger. For the smaller, the number of pounds of cell, complete in glass jar, per kilowatt-hour, for a 10-hour rate is 166 to 128, and for the larger 103; for the plates alone, for a four-hour rate, these figures are 200 to 160 and 125, averaging about 25 per cent. more.

Making similar deductions for the power, as distinguished from the capacity, it will be found that the 100 to 350 ampere-hour cells discharge at the rate of about 0.3 to 0.4 ampere per pound of cell complete, and the larger ones at 0.5, for a 10-hour rate; for a four-hour rate these figures are just twice as great. The former deliver 0.6 to 0.78 and the latter about 1.0 watt per pound, and nearly double this for a four-hour rate. This is at the rate of 1600 to 1300 pounds per kilowatt for the smaller and 1000 for the larger for a 10-hour rate; for a four-hour rate these figures are a little over one half as great. Reducing these to a common basis, the former corresponds to about 160 to 130 pounds per kilowatt *per hour* for the smaller and 100 for the larger, at a 10-hour rate, or 210 to 165 and 133 at a four-hour rate. All these figures are, of course, mere approximations.

Similar figures may be obtained for the cost of the cells; those here used are the list of prices in the catalogue. The cells are the same as those used above for illustration, and will be referred to simply as the smaller and larger ones respectively; the former are in glass cells and the latter in lead-lined wooden tanks. Considering first the capacity, the first cost per ampere or watt-hour is about the same for the 100 to 350 ampere-hour type as for the 1000 to 5000 ampere-hour type, though for the same type it is less, the larger the size; the first cost varied from eight to nine cents per ampere-hour for a 10-hour rate and 9.5 to 11 for a four-hour rate. Per kilowatt-hour at a 10-hour rate, the first cost varies between $41 and $48 and for a four-hour rate about $50 to $58.

Lastly, comparing the first cost and the power, the smaller ones cost from $410 to $480 per kilowatt for 10 hours, and $210 to $250 for four hours; or, reducing them to the same unit, this amounts to from $41 to $48 per kilowatt *per hour* at a 10-hour rate, and $53 to $62 at a four-hour rate, or about 28 to 30 per cent. greater.

All these figures must, of course, be taken only in a general way, as a basis for comparisons, and it must be remembered that they are taken from a mere catalogue.

Unfortunately, the writer has no such complete set of figures at hand for a commercial cell of the Planté type, but the results of some recent tests of a lead-zinc accumulator (generally known as the Reynier type) may be of interest as showing what can be expected of such cells, constructed specially for rapid discharges. The positive plates were of the Planté type with a very large surface, and the negatives of electrolytically deposited zinc. A small cell, of about 80 ampere-hours, had a capacity of about 3 ampere-hours per pound complete in rubber jar, for a 1½-hour rate, and about 2.5 for a 30-minute rate; expressed in watt-hours, the capacities were about 7.2 and nearly 6.0 respectively. The power developed was at the rate of over 4.5 watts per pound, for the 1½-hour rate, and nearly 11 for the 30-minute rate, which correspond to about 222 and 92 pounds per kilowatt, respectively, the former being at the rate of about 150 pounds per kilowatt *per hour*, and the latter 184. Although these last figures do not differ materially from those given above for the Faure type, it must be remembered that the rate of discharge was a very rapid one, for which it is much more difficult to construct a light accumulator.

These deductions, for both the types, show the importance of distinguishing clearly between the capacity and the power, as was pointed out at the beginning of these notes. By being careful to always take into account the rate also, no confusion ought to arise.

* Continued from THE ELECTRICAL WORLD, March 14, 1896, p. 292

Grounding Dynamo Frames.

To the Editor of The Electrical World:

SIR:—In the article "Central Station Working," in your issue of Jan. 11, 1896, one item mentions the grounding of the frame of the dynamo to earth to carry off the static discharge from the belts. I consider this very hazardous for the reason that if the line became grounded, every part of the insulation on the dynamo would be subjected to the full difference of potential; or, more plainly, for two coils of an armature to be short-circuited on the core, or one coil with the field through the frame, two insulations have to be pierced, but if the frame is grounded to earth and the line outside becomes grounded, then only one thickness of insulation stands between the full pressure of the dynamo.

This arrangement of grounding the frame would also increase the liability of a lightning discharge burning out the machine. A much better way I have found when discharge combs, placed near the belts, would not carry off the static current sufficiently, was to place an ordinary line lightning arrester, of the non-arcing metal type, between the frame and a good earth connection. This furnishes an easy path for the discharge with the metallic connection to earth broken by an air gap. What serves equally well for the purpose is an incandescent lamp with a good vacuum, but the filament broken off. This is from the fact that a static discharge takes place in vacuua more readily than in air. The discharge will occur across the ends of the two platinum wires, thus making a high-resistance path, so far as the current of the dynamo is concerned.

DURANGO, COL. R. H. STERLING.

An English Joke.

To the Editor of The Electrical World:

SIR:—You quote from the London *Electrical Review*, as follows: "A curious error occurs in Mr. Park Benjamin's work on 'The Intellectual Rise in Electricity.' An experimenter is stated to have held his *wife* in his left-hand and felt a smart shock the instant the circuit was closed."

The passage which contains the typographical error referred to and which appears to have escaped a six-fold reading of the proof by several persons, is actually as follows:

"With the aid of several members of the Royal Society, he laid a wire along Westminster Bridge—a distance of some 1,200 feet—and carried its ends to the water's edge. On the Westminster side of the river one of the company held the *wife* in his left hand and touched the water with an iron rod held in his right."

The misprint is certainly amusing, but it is less funny than the *Electrical Review's* obvious belief that only by the aid of such a manufactured quotation could the penetration of the joke into British intelligence be assured. PARK BENJAMIN.

NEW YORK.

A Year's Supply of Copper for Transmission Plants.

A good idea may be gathered of the extent to which transmission of power by electricity is gaining ground in this country, from the statement that in the long-distance plants installed by the General Electric Company during 1895, over 1200 miles of copper wire for transmission purposes alone were used, amounting practically to 1,200,000 pounds of copper.

New Properties of Röntgen Rays.

The recent increase in the price of Crookes tubes and of barium-platino-cyanide might be termed "the Röntgen raise."

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Graphical Calculations of Multiphase Motors. HEYLAND. *Elek. Zeit.*, Feb. 27.—A communication of some length discussing the recent article of Behrend (*Digest*, Feb. 22); it is followed by a reply from Mr. Behrend, in which he also refers to the article in English (*Digest*, March 7), in which he says Heyland gives a theory which is correct.

Graphical Theory of Polyphase Motors. BLONDEL. *L'Ind. Elec.*, Feb. 25.—He refers very favorably to the article of Behrend (*Digest*, Feb. 22), but states that this writer has not given the complete solution; in the present article he gives such a solution in connection with that of Behrend.

Polyphase Motors. See abstract below on *Polyphase Currents*, under "Installations."

Iron-Clad Arc Dynamos. Elec. Eng. and *Elec. Rev.*, March 4.—An illustrated description of some length of the Western Electric Company's machine.

POWER AND HEAT.

The Electrical Drying of Fruit. Lond. *Elec.*, Feb. 28.—It is suggested that there appears to be a good opening for the use of electric heating in connection with the fruit trade; although the process of drying fruit is comparatively a simple one, yet it necessitates great care and a careful regulation of the temperature; heating with steam may be cheap on a large scale, but is not always as satisfactory on a small one, while fuel is often expensive, but water-power in fruit districts is usually abundant; in such situations electric heating could be used with advantage, while the electricity could be used at the same time for other purposes; it is thought that a fine field for development is offered in this direction.

Electric Elevators. Lond. *Elec. Rev.*, Feb. 28.—An illustrated description of an English type, the general design of which is similar to that of the Otis elevator.

TRACTION.

Heilmann Locomotives. GRIEGER. *L'Ind. Elec.*, Feb. 25; an abstract of a paper recently read before an engineering society.—On referring to the two new locomotives, which are now constructed, he states that the old locomotive could develop only 600 hp, while the new ones ought to develop 1400. The most powerful French locomotives have a grate surface not exceeding 2.40 sq. m, while the new locomotive has 3.42. An ordinary steam locomotive weighs 48 tons and its tender 35 tons, making a total of 83, and it develops easily 850 to 900 hp; the electric locomotive weighs 120 tons and has 8 axles; the first Heilmann locomotive weighed 115 tons, and had a power of 16 hp, while the new ones have a weight of 120 tons and develop a power of 1350 hp; at a speed of 60 miles per hour the "rolling resistance" of the old form was 7 kg per ton, while with the new ones it is 12.5 per ton at a speed of 37 miles per hour; the efficiency, that is the ratio of the indicated power to that developed on the axles, is about 70 per cent., which is better than that for the best steam locomotives, which reaches to about 60 per cent., but is ordinarily 50 to 55 per cent. There is a decided advantage in the electric locomotive in the diminution of energy expended on grades; the electric locomotive will descend at a constant velocity a grade of 0.7 per cent., at a velocity of 100 km per hour, while for an ordinary locomotive, for obtaining a speed of 100 kw per hour, requires a grade of 1.3 to 1.4 per cent.; the engine is to run at a variable speed, but at a constant expansion.

Cost of Operating English Railways. Lond. *Elec. Rev.*, Feb. 28.—A short discussion of the operating costs of the Liverpool overhead and the City & South London underground electric railways. For a train mileage of 321,417 the Liverpool line spent about $18,000 in the latter half of last year, while the City & South London, with 227,350 train miles spent about $2300; the latter line is about half as long as the former, but this hardly accounts for a difference of about eight times the cost; considerable sums are spent by the Liverpool line in operating swing bridges, the repairs of the structure and the bridges alone absorbing $6200; the cost per train mile is given itemized for two years and shows a slight reduction to 29.02 cents for the underground, while for the overhead it is increased to 25.84; the costs per train mile for locomotive and generating power are only about half as much for the latter, but cost for the maintenance of the way and the works is over five times as much; the lower cost per train mile is partly accounted for by the heavier train mileage on the overhead line, but the larger train mileage on the City line would probably not have brought the cost down to the favorable figure for the overhead line; in the underground a considerable amount in the item of traffic expenses is due to the hydraulic power for the elevators; the City line obtains a considerably higher sum per mile, but the increase in receipts on the Liverpool line are most marked; the cost of working the overhead line is said to compare favorably with the best managed steam locomotive system.

Three-phase Traction System. GERARD and HENRARD. *Bull. l'Ass. Ing. El. Montefiore*, Jan. 24.—In a long article on polyphase currents, abstracted below, there are a few references to the line at Lugano, Switzerland, brief references to which have already been given (*Digest*, Feb. 22). They state that the three-phase motors are started by placing resistances in series with the armature; it is claimed that one of the advantages of this three-phase system is that there is no electrolytic corrosion of the water pipes. It appears that great difficulties have been encountered; the impedance of the circuit was found to be important; if the speed of the motor is to be varied, a resistance must be inserted in series in the armature, which absorbs a large amount of the useful energy; the regulation of the speed involves difficulties; a variation in the ratio of 1 to 2 to 3 can be obtained by modifying the "coupling of the poles of the magnets," but gradual variation can be obtained only by inserting resistances, which are said to absorb quite serious amounts of energy; the constructors recommend varying the speed mechanically by means of conical pulleys, friction discs, etc.; on the other hand, such motors assure a constant velocity in a most perfect manner.

Lond. *Elec.*, Feb. 28.—In a few notes on this installation at Lugano it is stated that the water-power has a capacity of 300 hp, which is used to drive two three-phase alternators of 150 hp each; the power is generated at 5000 volts, a portion of it being used in a neighboring factory; the only moving parts on the generators are the iron star-shaped pole cores, both the field coils and the armatures being stationary. The current is conveyed a distance of 7.5 miles where it is transformed down to 400 volts; there are two trolley wires, the third conductor being the rails; a special form of controller is used to vary the speed or for reversing; the motors are designed for a normal speed of 9⅜ miles per hour.

Earth Return Currents. CAPP. Lond. *Elec. Rev.*, Feb. 28; an abstract of the article noticed in the *Digest*, Feb. 15.—In addition to what was then stated it might be added that he demonstrated that earth currents are reduced in proportion to the third power of the number of points to which the return feeders are connected, according to which it would be possible to reduce these currents to harmless proportions at moderate costs.

Development of Electrical Traction Apparatus. PARSHALL. Lond. *Elec. Rev.*, Feb. 28.—The beginning of a reprint of a paper describing and illustrating the more important details of the machinery specially developed for use in electric traction; it appears to refer chiefly to the apparatus used in this country.

Regulation of Railway Motors. Elec. Ry. Gaz., Feb. 29.—An editorial note claiming that a certain notch in many types of controllers had better be left out; it involves a shunting of the field coils to weaken them, and it is claimed that this is uneconomical on account of the dead resistance, and also that it is quite unnecessary; by sending the current through only a portion of the field coils exactly the same result is accomplished and the energy saved; it might necessitate a few more contact fingers on the controller, but the extra complication is very slight in comparison with the gains.

Test of the B. & O. Locomotive. Elec. Ry. Gaz., March 7; *Elec. Eng.* March 4, and *Elec. Rev.*, March 11.—A short article giving the results of some recent tests, including a few curves for the current, the draw-bar pull and the acceleration, showing the relations between the consumption and the work.

Double-Trolley System. BALDWIN. *El'ty*, March 4.—A conclusion of the article, the first part of which was abstracted in the *Digest*, Feb. 22; it is a continuation of the illustrated description of the system used in Cincinnati.

Colorado. DICKINSON. *Elec. Ry. Gaz.*, March 7.—An illustrated description of some proposed electric railways in that State.

Ossining Railway. Elec. Ry. Gaz., Feb. 29.—A brief, illustrated description.

Circuit-Breakers vs. Fuses. HARRINGTON. *Elec. Ry. Gaz.*, Feb. 29.—A brief communication referring to some recent criticisms in that journal. It is claimed that the statements which were made are erroneous; it was

stated that the circuit-breaker is unfitted for car service, as it would open in an emergency reversal and that fuses were better adapted on account of the time margin; after a series of tests he found that when a circuit-breaker opens, following a reversal, the current which opens it gives one of the motors an initial magnetization, causing it to become a generator furnishing current to the other motor, thereby acting as a brake; he claims that the use of circuit-breakers on cars under such severe conditions has demonstrated their effectiveness; the above method, however, is not always successful, as the motors must build up, and it is here that the magnetic circuit-breaker plays an important part. The second statement complained of is that by making the armature pass through a considerable distance before it drops the catch, and by retarding its movement with a dash-pot, a circuit-breaker would excel a fuse; he expresses great surprise at this statement, as the momentary carrying capacity of fuse metals is one of the chief reasons for their condemnation, and that it would be an egregious error to embody this feature in an automatic circuit-breaker. In the reply it is stated that Harrington had overlooked the fact that a circuit-breaker with a time margin could be made adjustable to any degree, which is not true of a fuse; it was stated explicitly that the sole advantage possessed by fuses is the time margin in cases of emergency; it is claimed that it is not the momentary abnormal carrying capacity of fuses which condemns them, but that the extent of the momentary current excesses varies widely, and cannot be brought within a reasonable limit. The force of the argument concerning the initial magnetization of one motor is not apparent; the current cannot pass through one motor alone, and if both are excited alike there can no braking action unless the armature is short-circuited, and just how these connections are to be attained in an ordinary controller is not clear; circuit-breakers are advocated unequivocally as compared with fuses, but until it has been practically demonstrated a failure it is thought that a happy medium is obtained for street cars in a circuit-breaker with an adjustable time margin. In a reply in the next issue, Mr. Harrington states that he cannot agree with the statements made, as practical demonstrations have proved their incorrectness; he claims that an adjustable time margin as a remedy for momentary rush of current is unnecessary as circuit-breakers are adjusted for a current from 20 to 50 per cent. in excess; for a momentary rush sufficient to open the breaker it is desirable that it should open at once; railway motors should stand some overload; he did not intend to convey the impression that one motor alone would give an initial magnetization as both motors are so affected, the stronger one running the other as a motor.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Polyphase Currents. GERARD and HENRARD. *Bull. l'Ass. Ing. El. Montefiore*, Jan. 24.—A long paper read before that society, giving a summary of their observations obtained in a tour through Germany and Switzerland; the paper is quite long and therefore only a few of the more important points can be given here. It appears that a frequency of 50 meets the requirements best, including the running of arc lamps and motors; regarding the number of phases it appears that polyphase generators are more economical than single-phase, owing to the better utilization of the surface of the armature; it was claimed that two-phase currents are better than tri-phase as the circuits and the arrangement of the lamps are simpler; also that a variation in the load on one of the phases in the former has less influence on the others, but this has been contested; the three-phase system has the enormous advantage of involving a reduction of 25 per cent. in the copper for the same voltage between the wires, as compared with single and two-phase systems. Different types of alternators are discussed at some length; they state that those with movable armatures and fixed fields are no longer made except for small powers; an important objection to those having a single field winding is the great development of the pole-pieces which increases the loss of flux due to the armature reaction, leading to a drop in voltage between an unloaded branch and one fully loaded, which difference in some cases is as much as 30 per cent., under which circumstances the regulation for lamps becomes impossible; the effect of the armature reaction is counterbalanced by a synchronous motor with a large moment of inertia running unloaded and having the function of a fly-wheel; experience with those generators in which the armature and magnet coils are both stationary while the iron moves, is not yet sufficient to enable one to give a definite opinion on the relative merits of those systems. The success of the polyphase systems is due to the simplicity of the motors; non-synchronous motors have now an efficiency equal to the synchronous, but owing to their being started more easily and not being stopped by overloads, they are now preferred by the chief constructors. The necessity of reducing the air gap in polyphase motors had led to the general adoption of armatures with teeth or perforations through which the wires are passed; the drum winding has been generally adopted; the only difference between the motors made by different makers is the method of starting; large motors are usually started without a load, and are provided with a loose pulley and a coupling; with the aid of resistances in series with the armature it is possible to start with a normal current, obtaining the normal torque, or with double the current for obtaining double the torque, and so on; placing the resistance in the inside of the armature and short-circuiting it after the speed is reached is a system which is no longer used; a similar one used by Siemens & Halske consists in winding the armature with two circuits for each phase, the number of windings being different; these coils are connected in opposition at the start, so that the current at starting is normal, but when the speed has been reached a sliding ring on the shaft connects these coils in parallel. In mines containing fire-damp the starting is accomplished by means of a transformer which enables one to double the current at starting, and reduce the voltage correspondingly; such transformers have two equal coils connected in series, each being wound around the side of transformer plates in the form of a square and having a connection at the point between the two coils. Whatever means are used for starting, it is always advisable to have a certain elasticity in the transmission apparatus, as for instance a belt which may slip at first; in an installation of Schuckert in which the motors drive pumps, the two pipes leading to the pumps are connected together through a valve in order that at starting, the work done by the motor is only that required to overcome the friction in the pumps; when the proper speed has been reached the valve is closed. A few remarks on the three-phase railway system at Lugano will be found above under the subject of traction. The cost and the efficiency of polyphase motors are at present equal to those of continuous-current motors; for small outputs the former are preferred and it is thought they will be cheaper when the patents have expired. Regarding transformers, it is stated that those in which the cores are connected are more economical and are used more largely than those in which there is a separate transformer for each phase; the loss in flux is reduced by alternating the primary and secondary sections of the coils and it can thereby be reduced 2 per cent. for lamp circuits and 6 per cent. for motor circuits between no load and full load; for large motors it is advisable to use transformers having a nominal power 50 per cent. greater than that required by the motors, and it is better to have several motors connected with the same transformer; if the motors are very large it is better to have separate transformers for the motors and the lamps. Regarding the equalization of the voltage, they state that if in a tri-phase system the different branches have different loads, there will be a difference of voltage which it is difficult to regulate at the station; motors on such circuits have a tendency to equalize these voltages; one can also use in the secondary circuits three cores, like those in a transformer, carrying three coils connected in triangle and in derivation to the three circuits; if there is a fall of voltage in one of them the coils of the other two are traversed by a stronger current, and thereby tend to raise the voltage of the other branch. Regarding the conductors, they state that oil insulators have been abandoned, as it is difficult to keep them in order; large insulators, with double or triple petticoats are preferred; in underground lines concentric conductors, or twisted conductors, contained in the same armature are used, and in these the impedance is negligible; the effect of capacity is very important in underground cables; on account of the resonance, due to combined action of the capacity of the lines and the self-induction of the generators, very intense "currents" can be generated on open circuit; these effects increase rapidly with the voltage, and therefore form one of the limits to the allowable voltage for underground circuits; ordinarily paper is used as the insulator, or some substance the basis of which is cellulose; few companies use more than 4000 volts with paper cables, and beyond this rubber is employed, although less suitable and having a shorter life than paper. In conclusion they describe, with a few diagrammatic illustrations, the tri-phase plant at Dresden and the central station at Chemnitz; from the description of these stations they conclude that the problem of running motors and lamps simultaneously on polyphase circuits has been solved, the conditions being as follows: The use of generators having a feeble armature reaction; the limitation, between suitable points, of the loss of voltage in the leads; and the use of means for starting the motors which enables them to be started without exceeding the normal currents; with these precautions, distribution of polyphase currents giving sufficiently satisfactory results is as reliable as with continuous currents, with the very great advantage of enabling one to use transformers for transmission to great distances, and avoiding the use of commutators.

Brighton and the Wright System. MAYCOCK. Lond. *Elec. Rev.*, Feb. 28.—He gives a few figures showing the operation of this station, which he claims to be very successful in many respects. He states that Brighton numbers more customers per one thousand of population than any other large town in Europe; 4 to 5 per cent. of the buildings of all descriptions are fitted with the light. Most of the article refers to the Wright system of charging, which is praised very highly. To prove its good effect it is stated that the mean day load in December, 1895, was 40 per cent. higher than that in the corresponding month of 1894, whereas the maximum peak of the load curve was only 26 per cent. higher; the sale of units per maximum kw at the station increased in two years from 800 to 950, which is an increase of the load factor of 19 per cent.; the capacity of the present station is 2000 hp. He thinks that the spread of lighting in that city is due to the encouragement offered by the Wright method of charging, according to which no reduction is given to a consumer until he has paid all his proportion of the heavy standing charges at the station, which in this case amounts to 85 per cent. of the total expenditure; 14 cents per unit is charged during the first 365 hours' use of the consumer's demand on the plant per annum, and anything beyond this is charged at the rate of 6 cents; he hopes soon to reduce the latter to 4 cents. In order to involve no extra clerical labor he devised an instrument which

shows at a glance how much is charged for at 14 cents, and how much at 6 cents; 16 other towns are adopting this system. In series with the consumer's meter is an instrument called a demand indicator which registers the maximum current taken at any time exceeding 10 minutes, during one month; it consists of a U-shaped thermometer tube partly filled with black sulphuric acid and having a sealed bulb at each end, one of which contains a platinoid strip through which the main current passes and which heats the air in the tube, forcing the liquid through the other limb until it overflows into the bulb where it is retained, the amount of it indicating the maximum current, which is read monthly; the average of this maximum for the three dark months of the half year is taken to represent the demand for that half year; after each reading the tube is tilted so as to allow the liquid to flow back. If the daily average use of current at that rate is under one hour it will be charged 14 cents per unit, but if greater all the excess is charged for at 6 cents; the instrument has a glass front and a scale which the consumer himself can read. Another important feature of that station is the combined system used in the residential districts and in which all the advantages of high and low-tension distribution are claimed to be secured; the high-tension alternating current in these districts is used for periods of heavy load, while the low-tension is used at other times; a description of this system is promised.

The Best Distances Between Transformers. Haas. *Elek. Zeit.*, Feb. 27.—An article in which he discusses, with the aid of simple mathematics, the best distances between transformers in systems in which there is a long row of incandescent lights, as in street lighting for instance; the incandescent lamps are connected in parallel between the secondaries of the transformers. When the transformers are far apart and the allowable drop small, the cost of the secondary leads becomes great and cost of transformers becomes less, as also that of their supports; when the transformers are close together their expense and that of their supports becomes greater while the cost of the low-tension leads becomes less; there must therefore be a most economical distance between transformers, and the object of the present article is to determine this. The cost of the high-tension line is not considered, as it is the same in all cases. His analytical discussion is accompanied by a numerical example; he finds that the cost of the copper for the whole distance increases with the square of the length of the sub-divisions, that is of the distance supplied by one transformer. His formulas are based on European figures, but the general character of the curves is of interest; from his equation he plots the curve for the cost of the copper, and that for the cost of the transformers and their supports; by adding these two he obtains the curve of the total cost and this is found to have a minimum point; these three curves are reproduced in the accompanying figure, the abscissas representing the number of groups into which the total distance is divided; in the particular case which he uses as an illustration this

minimum is when the distance is divided into 12 to 14 groups. Having determined these he then shows how to use his formulas for determining all the other factors on this basis. The error in these calculations may be as high as 5 per cent., but this is not important, as the variation near the minimum point is very slight. The same method may be used for three-phase and three-wire systems.

Residence Switchboards. Hubbard. *Elec. Eng.*, March 4.—A short, illustrated description of some switchboards for private residences.

ELECTRO-PHYSICS AND MAGNETISM.

Discharging Positive Electricity by Means of Light. Elster and Geitel. *Elek. Zeit.*, Feb. 27; abstracted briefly from *Wied. Ann.*, Vol. 57, page 24.—Branly stated last year that positive electricity is dissipated by ultra-violet light, while heretofore it was assumed that only negative electricity was affected in this way. The authors repeated the experiments of Branly, but could not obtain the same result, and therefore concluded that it was not correct; they think it may be explained by the fact that the negative electricity in neighboring metallic bodies was discharged.

Discovery of the Electric Arc. Smirnoff. Lond. *Elec.*, Feb. 28.—He claims that it was not Davy, but Petroff, of St. Petersburg, who discovered the arc in 1802, using a battery of 4200 cells. In a reply by the editors it is stated that Davy's experiments began in 1800, the *Phil. Mag.*, 1801, being cited as a reference; in 1802 Davy had already shown the light in the Royal Institution, using a battery of 150 pairs of plates.

Magnetic Tractive Force. Jones. *Phil. Mag.*, March.—In a former paper read a year ago he gave an account of experiments in which the magnetic tractive force of a divided ellipsoid was found to agree within 1 per cent. with Maxwell's expression for the magnetic stress in the air space; in the present paper further experiments are described, the chief object of which was to see whether the same agreement existed at much higher inductions.

Roentgen Rays. L'Ind. Elec., Feb. 25, contains in full a number of the French Academy papers, which were abstracted in the *Digest*, March 7. The same journal states that Dufour, in using as an object the hand of an infant, found from the photograph that the ossification of the small finger was imcomplete; a sort of trough partially filled with blood showed only a scarcely noticeable difference in the intensity between the empty part and that filled with the blood. It also contains another Academy paper by Moreau on the photography of metallic objects by means of a brush discharge from an induction coil, without the aid of Crookes tubes. When using Crookes tubes he found from the measurement of the shadows that the active rays seemed to come from the positive terminal of the tube; he then used the brush discharge from a large induction coil, the positive being a point and the negative a plate; the sensitive plate was enclosed and placed first perpendicularly and then parallel to the discharge; nothing was obtained when they were perpendicular, while when placed parallel very fine and intense negatives were obtained; the maximum action was obtained at the height of the discharge and it showed that the active rays came from the positive pole; some of his photographs showed a noticeable absorption of the rays of an appreciable refraction, which, however, he was not able to measure exactly; with an influence machine he obtained nothing. In another paper by Lannelongue and Oudin, which is briefly abstracted, they state having made records of the thigh and knee of subjects in which these parts were diseased; the records confirmed the previous diagnosis, but showed nothing new. In a Physical Society paper by Raveau, briefly abstracted, he states that he considers it premature to conclude from the absence of reflection and refraction that it was out of the question to connect these rays with the ultra-violet; formulas for absorption given for the index of these radiations of extremely short periods, a value which approaches unity; the X-rays could then simply be very rapid transverse vibrations, which is not contradictory to the experiences of interference and diffraction; theory supposes the existence in all transparent bodies of an energetic absorption band in the ultra-violet beyond which the index is at first small; the existence of this absorption band has been demonstrated for many bodies, including atmospheric air; for silver for which the transparency increases toward the violet and of which the index has low values, the absorption band would be in the visible spectrum. In another paper by Broca it is claimed that there is no essential difference between the Lenard and Roentgen rays; he attributes the differences noticed to the energy of excitation and thinks it may be a difference in the wave length. De Chardonnet recalled having shown 15 years ago before that society photographs obtained by means of ultra-violet rays which had traversed a sheet of silver.

The *Elek. Zeit.*, Feb. 27, states that a bas-relief in stone, when photographed with these rays, gives an image quite like an ordinary photograph. In reference to the Spies and the Salvioni method of seeing shadow pictures directly, that is, without the use of the sensitive plate, it is stated that the image is very faint, and it is therefore necessary in such cases, in order to apply this system in practice, to generate more powerful Roentgen rays, or to find more intensely fluorescent materials.

Mr. Preston, in the Lond. *Elec. Eng.*, Feb. 28, suggests that possibly under powerful inductive influences the molecules of a body may undergo some rearrangement, perhaps a symmetrical and polar arrangement like that in soft iron when magnetized, and that a body with its molecules thus arranged may allow certain rays to pass through it which it would otherwise not do, and under these conditions it might allow some of the rays of ordinary light to pass through.

Black Light. Le Bon. *Phil. Mag.*, March.—A translation in abstract of his paper noticed in the *Digest*, March 7.

The Production of Electrical Phenomena by the Roentgen Rays. Righi. *Phil. Mag.*, March.—A reprint in English of the paper noticed in the *Digest* last week.

Energy Dissipated by Magnetization. Mourain. *L'Ind. Elec.*, Feb. 25; an Academy paper.—He describes experiments made to find how the energy which is converted into heat during magnetization varies with the frequency of the magnetic field; the heat was measured by placing a fragment of the magnetic material in a cylindrical reservoir of glass to which is attached a calibrated capillary tube, the whole being filled with alcohol; this is placed in the interior of a long coil, producing a uniform

field; when an alternating current flows through the coil the heat generated in the iron will be measured by the rise of liquid in the capillary tube; the heat is due to the magnetization on the one hand and to the induction of currents on the other; the latter are avoided by using very small pieces of iron. To study the effects of the frequency the current was kept at a constant value; the method is said to be very sensitive and is subject to two corrections, the temperature of the surrounding air and the loss of heat through the tube; in spite of the precautions taken the corrections introduce an uncertainty, which he reduced as much as possible; to reduce the loss of heat he states that the curve representing the variation in the level as a function of the time is a straight line which becomes curved as soon as the loss of heat is appreciable; the measurement should therefore be made during a time short enough to correspond with the straight line portion of the curve. For wires of iron 0.5 mm in diameter, he found that for frequencies from 10 to 63.3 the relative values varied from 1 to 0.745; with steel wires of the same diameter and frequencies varying from 13.4 to 65.5 the relative values are 1 and 0.755; this shows that the quantity of heat dissipated during a period diminishes as the frequency increases, the diminution being less and less. With copper cylinders he found that in accordance with theory the heat increased nearly in linear proportion with the frequency. He then used different strengths of field and found that the relative diminution of the heat is independent of the intensity of the field. To explain why the energy diminishes when the frequency increases, he suggests that it might be due to the screening action of the superficial layers of the magnetic body.

Experiments on Cathode Rays and Their Effects. WRIGHT. *Am. Jour. of Sc.*, March.—An article accompanied by two plates giving results of his investigations at Yale University. It contains numerous results interesting to physicists; among other things he shows photographs of streams of these rays passing through slits and leaving their trace on the plate; although the path is generally rectilinear for the first part, there is an outward curvature which increases with the distance; they show the mutual repulsion of the two streams; the effect of a magnet was shown by a small deviation in the direction expected.

Observations with Roentgen Rays. ROWLAND, CARMICHAEL and BRIGGS. *Am. Jour. of Sc.* for March.—A short article giving the results of some of their experiments. Efforts to deflect the rays with a strong magnet either within or without the tube failed; prisms of wood and vulcanite have no action; no trace of reflection from a steel mirror could be observed. The best results were obtained with a tube having aluminum terminals within 1 mm of each other and intended for showing that electricity will not pass through a vacuum; the vacuum was so perfect that sparks preferred 10 cm in the air to a passage through the tube, but by using a sufficiently high potential the discharge from a coil could be forced through; it was not oscillatory, but went only in one direction; with this they demonstrated conclusively that the main source of the rays was a small spot on the anode nearest to the cathode, and in addition to this the whole anode gave out a few rays; no rays came from the cathode nor from the glass of the tube; this tube far exceeded all of the Crookes tubes which they had, and gave a full exposure at 5 or 10 cm in about 5 or 10 minutes with a slow-acting coil giving about four sparks per second. The next best results were obtained with poles 3 cm apart, and the source was found to be two points in the tube a little on the cathode side of the middle; in other tubes there seemed to be diffuse sources, but in no case did the cathode rays seem to have anything to do with the Roentgen rays; the latter seemed to be more connected with the anode than with the cathode. *El'ty*, March 4, reprints a greater portion of the article.

The *Sc. Amer.*, March 7, reprints from a German paper an X-ray photograph of the veins in the hand of a corpse, Teichmann's mixture, which consists of lime, cinnabar and petroleum, having been injected into them; there is also a photograph of a canary bird.

The CASE aluminum vacuum tube is illustrated in the *Elec. Eng.*, March 4; it is made entirely of aluminum about 6 inches long and 1 inch in diameter, the tube itself being made the anode; he adds that the shape and arrangement is probably not the best, as the rays are thrown in every direction.

Light Rays Resembling X-Rays. HODGES. *Elec. Eng.*, March 4.—He calls attention to properties of the X-rays which are common to certain radiations that have heretofore been classed as light rays, and describes some experiments from which he concludes that it appears "that the violet rays which result from anomalous dispersion of sunlight by refraction through a prism of fuchsine have a power of penetration for paper, leather, wood and black cloth, which substances are opaque to the whole light of the sun."

Computation for Coil Windings. BAKER. *Elec. Rev.*, March 4.—A short article deducing simple formulas for predetermining the proper dimensions of a wire for a coil.

ELECTRO-CHEMISTRY AND BATTERIES.

Dry Cells. Lond. *Elec.*, Feb. 28; a report by Dr. Walmsley on the Lessing dry cell; the Lond. *Elec. Eng.* contains an abstract of it.—This cell belongs to the modified Leclanche cells; the outer jar is porcelain and is securely sealed; the height is 6.3 inches and the external 3.1, the weight being 3 lbs. 2 oz. Three cells taken at random were tested, the E. M. F. being 1.470 volts; the internal resistance, when generating very heavy currents, varying from 2.25 to 3.75 amperes, was 0.222 to 0.121 ohm. They were discharged continuously for 45 hours with a current of 113 milliamperes at the start and 36 at the end, and the tests were considered very satisfactory; the E. M. Fs. at the end were about 78 to 75 per cent. of the original values, while the average resistance at the end was a little over 0.4 ohm; in a 4 days' rest they nearly recovered. Results show that these cells compare very favorably with other forms of dry cells as shown by published tests. A second, more extended test is also reported on; in one of these the starting current was as high as about 0.5 ampere, which was maintained fairly well for more than six hours with a fall of less than 7 per cent. in the current, but after this they fell rapidly; another continuous-current test was made with 42.5 milliamperes, which approximates the currents usually required of such cells. The tests are said to show that when the cells are in good condition currents from 25 to 28 milliamperes may be taken continuously for 260 hours or longer, which is considered a very satisfactory result. He considers that they are admirably adapted for generating intermittent currents of the magnitude usually required for many purposes, and that they also have good recuperating power; in no instance did a cell show any sign of bursting or of mechanical leakage. Editorially it is stated that while the internal resistance is initially low, the polarization appears to be somewhat rapid, and the life is shorter than might have been expected.

Indicated Evolution in the Storage Battery. PAGET. *El'ty*, March 4; the conclusion of his article (*Digest*, March 7).—He maintains that the "offending member" of a secondary battery is the negative and not the positive plate; he thinks the Planté principle of formation is the one which is most fit to survive and recommends that the layers should not be too thick, as the long capillary passages formed by the outer portions of a deep layer must be avoided; he states that he has shown, and that it was confirmed by Planté, that in a Planté cell there should be formed for every ampere-hour 4.48 grammes of peroxide; this he considers shows that as an effective means of storage the positive plate when properly formed and constructed leaves but little to be desired; it is necessary to adhere to the electrolytic formation as no other formation yields anything like the results. For perfection a thorough reconstruction of the cell including a discarding of the present negative plate is necessary; it can never be so economical in weight as the positive, and the efficiency of the reduced lead is very much lower than that of the peroxide; the reduced lead is very easily clogged by sulphating; he recommends returning to metals deposited from solution as the negative electrode and believes this to be strongly indicated as the required evolution; he states that it is admitted that there are drawbacks to a lead-zinc cell, for instance such as local action and "treeing," but the higher voltage greatly reduced weight and the much higher efficiency per unit of weight, are not all the advantages to be obtained; for the present lead-lead battery a greater output than 6.5 hours per pound of complete cell has never been attained, while lead-zinc cells can give 10 to 11, and with a somewhat similar type 14 to 15 can be attained; he claims with a cell giving eight watt-hours per pound the problem of traction can be solved; the lead-zinc type also solves the question encountered by central-station engineers in the decrease of capacity for rapid discharges; a lengthy experimental practice with cells of the lead-zinc type has shown him that when constructed properly they give as great an output under discharges from two to four times their normal as at that rate; but what that normal rate is, he does not state.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measurement of Self-Induction. ARMAGNAT. *L'Ind. Elec.*, Feb. 25.—He calls attention to the usefulness of measuring the self-induction, adding that it is one of the measurements least frequently made in practice; the measurements can only be of a comparative nature as there is no exact and practical formula for calculating the coefficient of induction of a coil in terms of its geometric dimensions; of all the proposed formulas that of Prof. Perry is the only one which gives relatively close results, within 5 to 10 per cent. In the measurements he suggests using the zero method; if the coils contain no iron, standards of self-induction are used; if the galvanometer is sufficiently sensitive the Maxwell method of comparison can be used; if not, the accuracy of the method can be increased by using the commutator of Ayrton and Perry, which reverses the direction of the current in the bridge and the galvanometer so as to obtain currents in the same direction; if the coil contains iron, the method of comparison of a self-induction to a resistance, indicated by Rayleigh, gives deflections proportional to the total flux, which is equal to the product of the current and the coefficient of self-induction; knowing the current or eliminating it, the value of the coefficient is obtained. From these same measurements interesting indications regarding the hysteresis may be obtained, for samples whose dimensions, and the nature of the iron of which, is unknown; to obtain the hysteresis curve in this way the Rayleigh method is applied by varying the current through a complete cycle but by successive variations; an ampere-meter is inserted in the circuit, as also a commutator and a resistance; the resistance is altered suddenly and the deflection due to the change in the current is observed; with a sensitive ballistic galvanometer and slow oscillations an accuracy of 1 per cent. in the sums of the negative and positive deflections (which

should be equal) can be obtained. By drawing a curve of the total flux as a function of the current it will be found to resemble the usual hysteresis curve and to have the same properties, the area enclosed being proportional to the work lost by hysteresis. This method enables one to determine the effect of hysteresis even when the volume of the iron and the maximum induction are not known; the results are comparable with all those methods in which slow variations are used; if the ampere and the henry are used as units, the area of the curve will be represented in joules. To apply this method to coils containing large currents, as in transformers, it is necessary to use the Thomson bridge, to which the Rayleigh method may be applied equally well; it suffices to make a Thomson bridge by means of a bar of brass or German silver of suitable diameter and by giving to the four resistances the best values for obtaining the greatest sensitiveness. He adds that this method of measuring coefficients of self-induction has always given him very good results with coils the resistance of which is low and the coefficient high.

Meldometer. Ramsay and Eumorfopoulos. Lond. *Elec.* and *Elec. Eng.*, Feb. 28; a brief abstract of a Physical Society paper.—This instrument, invented by Joly, consists essentially of a thin platinum strip, which can be heated by the passage of a current, and is intended for the measurement of high temperatures; small fragments of a solid substance are placed on the strip, and the temperature at which they melt is deduced from the length of the platinum strip, that is, from its expansion. The results of a number of measurements appeared to differ considerably from the temperatures determined by Haycock and Neville, and the authors have not been able to account for the differences; the chief advantage of the instrument is that only a very minute fraction of the substance is required for the measurement, and that extreme purity can therefore be secured; they state that the zero was constant within a quarter of a degree. (It would seem that only such substances as did not alloy with the platinum can be tested, except at a sacrifice of the calibrated piece of platinum.)

Voltmeters, Ammeters and Wattmeters. Maycock. Lond. *Elec. Eng.*, Feb. 28.—A brief, illustrated description of the new Swinburne instruments.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Intercommunication on Railway Trains. Pigg. Lond. *Elec. Eng.*, Feb. 28.—A brief, illustrated description of the electrical system used on the Southeastern Railway, to replace the usual overhead cord for communicating from any part of the train to the locomotive.

Cable Defence Scheme. Snell. Lond. *Elec. Rev.*, Feb. 28.—A brief, illustrated description of his method (*Digest*, last week).

Military Telephony. Elec. Rev., March 4.—A reprint with some of the illustrations of the article mentioned in the *Digest*, March 7.

MISCELLANEOUS.

Poplar Trees as Lightning Rods. Hess. *Elek. Zeit.*, Feb. 27.—The first part of an article in which he discusses the subject of trees in general and their tendency to be struck by lightning, with special reference to the poplar. Jonesco made experiments with pieces of wood of different kinds placed between the poles of a Holtz machine, using as an indicator the quantity of electricity which much be accumulated before a spark passes, from which he determines the conductivities of different kinds of woods; he concluded that woods containing fats were in all cases poorer conductors while those containing starch were better conductors; among the latter the best were poplar, oak and willow, and it was concluded that therefore the poplar tree was a good lightning conductor; other authorities are cited, one of whom concluded that poplars planted near buildings would be good lightning rods; he discusses the latter conclusion and shows that by their position they may become more dangerous than useful and he endeavors to determine the best and worst distances; he cites a number of cases and shows that by increasing the number of trees the protection is not increased and that absolute protection is not obtained even by a circle of trees; in a number of cases cited the lightning jumped from the trees to the house; he concludes that the danger in the current jumping from the trees to the roof of a building is very great when the distance between them is less than 200 cm (6.5 feet).

Automatic Interlocking Switch System. Zeit. f. Elek., Feb. 15.—An illustrated description of Natali's system.

Action of High-Frequency Currents on Bacterial Toxines. D'Arsonval and Chanin; *L'Ind. Elec.*, Feb. 25; an abstract of an Academy paper.—As continuous currents produce chemical action, due to electrolytes, results obtained with them may be due to the chemical forms and not to direct action of the currents; they therefore used high-potential induced currents, and showed that the modifications of the toxine has no connection with the quantity of the electricity; the currents were communicated so as to be always in the same direction; the results showed that the action of the discharge was very much greater than that of electrolysis; to eliminate electrolytic action entirely they used high-frequency alternating-currents, the calculated frequency being 225,000; the effective current was found to be 75 amperes and the mean density 250 milliamperes per square centimetre; the results showed that such high-frequency current weaken the bacterial toxines, and that the toxines thus weakened "increase the resistance of the animals into which they have been injected."

Carbide of Uranium. Moissan. *L'Ind. Elec.*, Feb. 25; an abstract of an Academy paper.—He discusses the subject of carbides, produced from the electric furnaces and showed that a definite carbide of uranium is produced, which is crystalline and has the formula C_3Ur_2; this body decomposes in cold water, giving off a carbide rich in methane, the other products being a mixture of liquid and solid carbides and bituminous materials; the presence of hydrogen in the mixture may be due to a secondary reaction; the decomposition of certain carbides is therefore quite complex.

New Books.

Mesures Electriques. Lecons Professees a l'Institut Electrotechnique Montefiore, Annexé a l'Université de Liège. By Eric Gerard. Paris: Gauthier-Villats et Fils. 457 pages, 198 illustrations. Price, 20 francs.

The author of the present work in his "Lecons sur l'Electricite," demonstrated that he possesses in a high degree a mastery of the difficult art of writing for students. The latter work is perhaps the best college text-book in any language on the theory of electricity, and the present one will, we believe, take equal rank as a treatise on the elementary theory and on the practice of electrical measurements. The matter of the book is of a distinct practical character. Elaborate mathematical expressions are avoided, the object kept in view being rather an exposition of the principles and methods utilized in commercial work, than to furnish guidance for laboratory investigations.

The first four chapters form an introduction, in which are treated the errors of measurement and discussion of results, mechanical and geometric measurements useful to the eleotrician, and photometric measurements. In the following two chapters standards of measurement, circuit-changers, keys, etc., are considered, after which the measurement of currents, E. M. Fs., resistances, capacities and power are taken up in turn, 16 chapters being necessary for this purpose. The remaining 15 chapters are devoted to practical applications, the subjects including electrolytes, earth resistances, telegraph lines, electric lighting circuits, dynamos and motors, transformers, etc.

One of the characteristics of the work is the concise, clear and simple manner in which the author develops the various considerations involved and points out their bearing. Formulas are surprisingly few; discussions of the principles concerned refer in almost all cases to simple diagrams pertaining to the special case considered. In this manner general mathematical expressions are avoided, the formulas for given cases being deduced directly in their simplest form.

Electric Heating. By Edwin J. Houston, Ph. D., and A. E. Kennelly, Sc. D., Elementary Electro-Technical Series. New York: The W. J. Johnston Company. 290 pages, 86 illustrations. Price, $1.00.

This little book is written in a style similar to that of the same authors' "Elementary Treatise on Alternating Currents," being devoid of mathematics and expressed in simple terms not requiring any previous electrical knowledge to understand. Though not claiming to be a general treatise on the subject of electrical heating, the subject is nevertheless very thoroughly covered, and the book enjoys the distinction of being the first published devoted entirely to it.

The book contains 10 chapters and an index, and also an introductory chapter consisting of historical and descriptive notes. The first chapter of the book proper treats of the elementary principles involved in heating, and of the terms in which they are expressed. The next chapter takes up the heating of bare conductors. It begins with the elementary electrical laws, and frequently uses suggestive diagrams and analogies. Tables of resistivity and similar data are given. The escape of heat from solid substances by convection, radiation and conduction is discussed, and some valuable empirical constants, the result of experimental labors, are given, which render calculation as accurate as possible.

Under the next chapter, which takes up covered conductors, safe temperature limits are discussed, and the limiting causes are clearly set forth. Methods of wiring are incidentally treated. Fuse wires, which occupy the next chapter, are exhaustively treated. The effects of copper tips and of heavy terminals are noted, and simple calculations are presented concerning them. The various types of fuse-blocks in common use are profusely illustrated, and an interesting discussion included upon the momentary current capacity of fuses. This last discussion is of interest not only to the elementary student, but to the experienced engineer as well.

The fourth chapter is devoted to electric heaters. Present practice is illustrated and the advantages of electric heating set forth. The relative cost of electric heating as compared with other forms is subjected to simple calculation, and set forth in an unbiased manner. Some of the more recent forms of electric heaters are shown, and series-multiple regulation discussed with respect to the comparative amounts of energy under various circumstances. Portable and special heaters are also illustrated and described. The next chapter takes up electric cooking, and shows various types of heating coils and ovens and their construction. The cost of current for various operations is carefully estimated under assumed rates, and the relative efficiency can therefore be readily appreciated. In addition, there are several heating devices described, such as

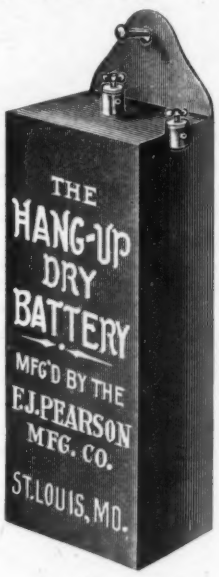
hair curlers, flat-irons, etc., which promise to become common household utensils. These special types are profusely illustrated.

Electric welding forms the subject of the next chapter. The necessities of good welding are described and the difficulties to be overcome are noted. It is then shown how electric welding will readily accomplish many difficult and heretofore impossible results. The question of power used, and the current and pressure employed, is discussed. Then various welding machines are illustrated, both for direct and indirect welding. Welding transformers of various forms, automatic welders, and special types are both illustrated and exhaustively described. A universal welding machine is also shown. Examples of difficult welds and various special apparatus form an important part of this chapter, while track welding, a recent achievement of great interest to electric railway engineers, forms an important closing feature.

The next chapter treats of electric furnaces, describing the elementary forms and the general operation of all furnaces. It then takes up the special commercial furnaces which are largely employed in the arts. The carborundum calcic carbide and aluminum furnaces are described as well as the processes of making these commodities. The size, power and cost of current in electric furnaces is discussed and the chapter closes by describing the process of making artificial diamonds. The last chapter considers miscellaneous applications of electric heating, including some of the more recent which have come into public notice since the main part of the book was put in type. The electric annealing of armored plates is given a special place in the chapter and the two methods of electric forging are also considered. One of these methods, the ordinary low-pressure method of passing current through the piece to be heated, is mentioned, and the water-pail forge, which has now become so prominent, is more thoroughly discussed. This apparatus is described and samples of the forgings are shown.

A New Dry Battery.

The battery illustrated herewith, manufactured by the F. J. Pearson Manufacturing Company, Security Building, St. Louis, Mo., has been christened the "Hang-up Dry Battery," from the method by which it is



DRY BATTERY.

installed. As will be seen, the battery may be hung from a nail, thus doing away with the necessity for a shelf or box. The square form also secures greater convenience in packing.

The Winter's Experience on the Lenox Avenue Conduit Road.

The underground road which the General Electric Company installed on Lenox Avenue, New York, has emerged successfully from the tests to which the severe snow storms of the last month have subjected it. During the violent snow storm of the 11th of March the operation of the road did not cease for an instant. The snow began to fall about 8 o'clock in the morning, and the snow sweeper was started out over the line, but before it could make the complete trip the sprocket-wheels of the broom broke, and it was necessary to push the sweeper back into the barn for repairs. Not until 4 o'clock in the afternoon was it ready to go out on the tracks again. Meanwhile the service of the road was conducted without any stoppage, and the cars ran over the unswept tracks with no greater delay than would be ordinarily caused by considerable slipping of the car-wheels on the snow-covered rails; it took about eight or ten minutes longer to make the trip.

At some points on the line the snow was swept by the wind into drifts, making it necessary for the motorman to back his car to get the necessary momentum to push his vehicle through the drifted snow. At 4 o'clock the snow-sweeper cleared the line of the snow and regular schedule time was again resumed.

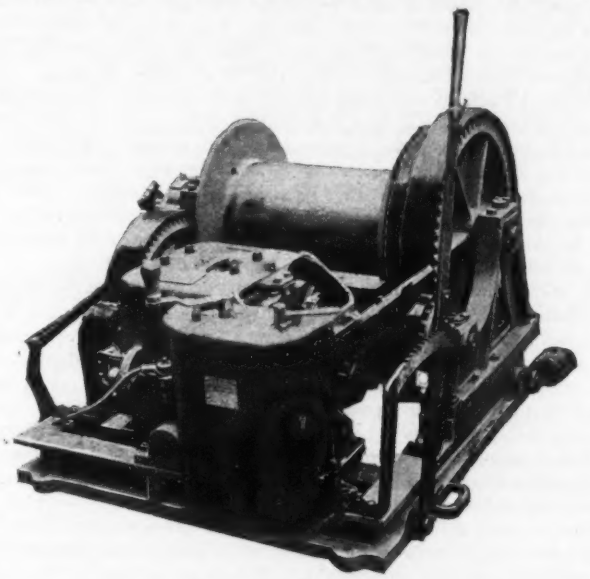
About 8 o'clock the storm turned to sleet and hail, and as it fell covered the rails with ice. Notwithstanding this the cars ran under their usual headway.

On the Lexington Avenue electric conduit road a gang of men swept the tracks, and on this line the cars made schedule time while the bad weather prevailed. Throughout the duration of the storm no electrical trouble of any kind was developed, either in the conduit or in the cars.

The rolling stock of the electric conduit lines of the Metropolitan Traction Company is now undergoing a large increase. Equipment has been started on a number of new cars and they will be put into service as soon as they are ready.

Electric Hoists.

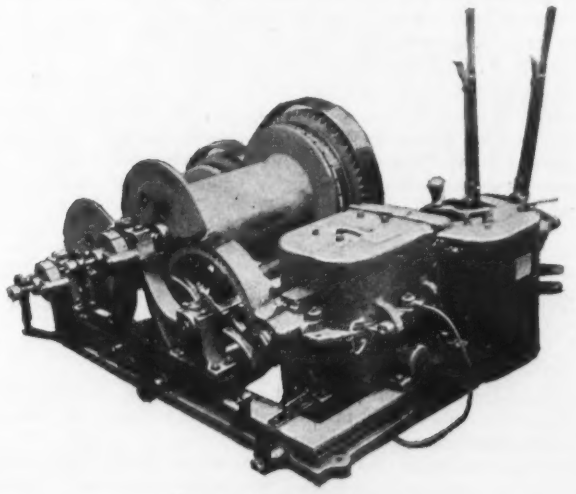
The application of the electric motor to portable hoists for derricks is well illustrated in the two hoists which the General Electric Company has lately furnished the United States Government in connection with an important electrical installation. These hoists are of the double-drum and single-drum type respectively, the double-drum hoists being operated by a 20-hp motor, the single-drum hoist by one of 10 horse-power. Each motor is mounted upon the same bed-plate as the hoist, and is of a late and effi-



SINGLE-DRUM HOIST.

cient type, resembling in general appearance that so extensively employed in railway service. The parts of the motors are all readily accessible for examination and repair, but are entirely covered in by the motor casing, being thus fully protected against dust, moisture and mechanical injury.

The armatures are iron-clad, each coil lying in a slot in the iron cone entirely below the outside surface. The motors are sparkless and the



DOUBLE-DRUM HOIST.

bearings are self-oiling. The controllers are known as "MR," and embody all the excellent features of the controller "K2," used in street-car work.

The levers for the brakes, controllers, etc., are so arranged that full control of the entire mechanism is had without change of position by the man in charge. The hoist themselves are from the works of the Lidgerwood Company. The drums are 14 inches in diameter and 26 inches long.

Primary Batteries for Closed-Circuit Work.

In selecting a battery for any particular work, it is necessary to consider the special service that is required of it, and then to examine carefully the various batteries on the market in order to ascertain which one most nearly conforms to the standard of perfection. The requisites of the ideal battery are: First—high *available* E. M. F.; second—low internal resistance; third—constant current; fourth—absence of local and chemical action; fifth—absence of noxious and poisonous vapors and gases; sixth—cleanliness, ease of re-charging and absence of attention to battery during entire life.

It is difficult to examine these points separately as the current depends upon the relation of the E. M. F. to the internal resistance. It should, however, always be remembered that the initial E. M. F. of a cell on open circuit is no criterion of its behavior in actual service. For instance, the various forms of the Leclanche batteries, including dry cells, have an initial E. M. F. of about 1.45 volts on open circuit. When the circuit is closed for a short period of time through a working resistance, such as a motor, electromagnet, spark-coil or electrolytic bath, the E. M. F. drops continuously during the entire time (the amount of drop depending entirely upon the length of time the circuit remains closed) until it falls to about .04 volts. It will thus be seen that this form of battery is absolutely useless for closed-circuit work, even supposing that the internal resistance remained normal, which is far from being the case.

The Daniell cell, of which the gravity battery is now the universal type, has on the contrary an almost constant E. M. F. of 1.079 volts during its entire life, but the internal resistance is high at the start and constantly increases. Taking the 6-inch by 8-inch Western Union model as a standard, the internal resistance rises continuously during its life until it reaches about four or five ohms. The local action in this cell is also so considerable when left on open circuit that it will rapidly exhaust itself. It is, therefore, always necessary to keep it on closed circuit.

The bi-chromate battery fulfills the first two requirements, as the E. M. F. is about two volts and the initial internal resistance is very low, but this latter is a constantly increasing factor, due to the growing resistance of the electrolyte, as the chromic acid, which is a good conductor, is converted into chromous acid, which is a poor conductor. The chemical action in this battery even during closed circuit is so great as frequently to cause the electrolyte to heat almost to boiling point, which makes it absolutely necessary to remove the zinc from the electrolyte immediately after using, and if this is not done it results in the total destruction of the entire charge.

These remarks will apply equally well to the Grove nitric acid battery and those cells using nitrate of soda or nitrate of potash as a depolarizer, combined with the further objection that the nitrous oxide fumes liberated are very poisonous and destructive. In these latter cells it is necessary to use a porous cup which considerably increases the internal resistance.

There remains yet one other battery to examine, the Edison-Lalande, which is in large use at the present time. This battery has an initial E. M. F. of .95 volt, which drops to .7 volt on closed circuit. It is made in a variety of sizes, each adapted to a particular class of work. As is well known, one element is zinc and the other copper oxide, in an electrolyte of a solution of caustic potash. Taking the "Type R" as a standard, this particular cell is 6 inches by 8 inches, the same size as the Western Union gravity battery. At first sight it appears that the E. M. F. is low. The internal resistance is, however, correspondingly lower (in this particular cell being only .043 ohm) and consequently it follows that the *available* E. M. F. (potential difference) is very high.

To take an instance: Two cells of 6 inches by 8 inches gravity battery, when first set up, will have an E. M. F. of 2.158 volts and internal resistance of 1 ohm. Two cells of Edison-Lalande battery of the above type will have an E. M. F. of 1.4 volts and an internal resistance of .086 ohm. Suppose these two different batteries each work through a resistance of 1 ohm. The resulting current will be:

	E. M. F.	Int. Res.	Ext. Res.	Total Res.	Current.
Two cells gravity.	2.158 volts	1 ohm	1 ohm	2 ohms	1.079 amperes.
Two cells Edison-Lalande.....	1.40 "	0.086 "	1 "	1.086 "	1.289 "

Furthermore, as is well known, the drop of E. M. F. across any particular resistance in a circuit is proportional to the ratio of that resistance to the total resistance of the circuit.

It follows, therefore, that the proportion of the E. M. F. absorbed by the internal resistance of the gravity battery is 50 per cent. of the generated E. M. F., whereas in the Edison-Lalande battery the E. M. F. absorbed in like manner is 8 per cent. If the external resistance were less, the results would be still more in favor of the Edison-Lalande. Again, in this case we have taken the gravity battery at its best, but on working the battery the internal resistance would constantly increase, which would absorb a correspondingly larger proportion of E. M. F. with a necessarily diminishing current in the external circuit. The internal resistance in the Edison-Lalande cell, on the contrary, falls during the whole life of the battery, on account of the negative electrode, oxide of copper (which is a bad conductor), being continuously reduced during the period that the circuit is closed, to metallic copper, which is a good conductor. This action virtually increases the size of the negative electrode, thereby lowering the internal resistance.

One of the chief points of superiority of this battery is the absence of local action when not in actual service. In an actual test made with 40 of these cells by Prof. A. E. Kennelly, at the time he was chief electrician at the Edison Laboratory, it was found that the average loss of zinc in each cell for a period extending over three months was a fraction over 1 per cent. per month.

In making this test the zincs in each cell were most carefully weighed on accurate balances when the battery was first set up, and again at the end of each month, with the above result.

Still another good feature is that no attention is necessary until the charge is entirely exhausted, that there are no noxious or poisonous fumes, and that the permanent parts of the battery do not deteriorate with time, as is the case with other batteries. This battery is now extensively used for all closed-circuit work requiring considerable current and it gives universal satisfaction. It can also be equally well employed for open-circuit work, such as burglar alarms, telephones, etc., and we predict a large future for it.

Curb and Conduit for Distribution of Electric Wires.

The accompanying illustrations show a system invented by Mr. William F. Phelps, 43 Germania Life Insurance Building, St. Paul, Minn., for the distribution of wires carrying electric currents, consisting of a conduit, which also acts as a curb for the sidewalk. The material is pressed iron and steel, amalgamated cast-iron and creosoted wood, which form a rectangular-shaped cavity provided with tubes that are insulating and

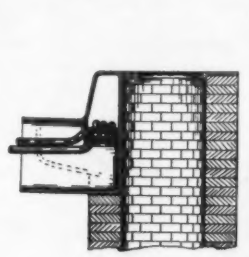


Fig. 1.

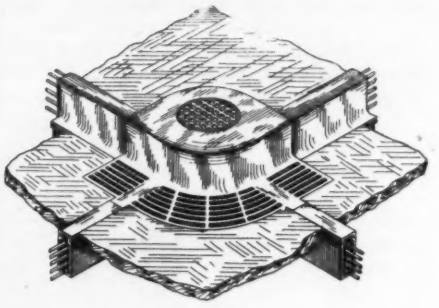


Fig. 2.

proof against chemical action, through which insulated wires are strung. Fig. 1 is a transverse section showing the form of the conduit and its relation to the street pavement, and also some of the tubing with wires in place, and the method of crossing intersecting streets. Fig. 2 gives a view of the method of construction at street corners, showing the arrangement of the conduit containing the tubes and wires as depressed for crossing the streets, together with the pavements, sidewalks and surface-gutter drainage in connection with a catch-basin. Fig. 3 is a sectional view of the conduit showing the tubes and wire and gutter for conveying the water to the catch-basins, together with the method of arranging the junction connections with the buildings to be served with current. It will be observed that the junction connections with the main tubes and wires are made with openings covered with slides or doors in the rear of the conduit, next to the sidewalk, covered pits being provided for the purpose. The interior of the structure is thus made easily accessible by means of these rear openings by removing the caps on the pavement side. In Fig. 3 is also shown the method of joining the two plates composing the conduit. It is proposed to bed the conduit in concrete or asphalt.

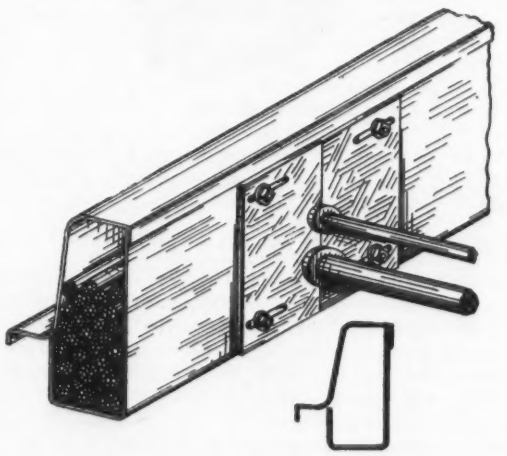


Fig. 3.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, March 14, 1896.

AMERICAN BELL remained quiet and steady at 202½ throughout the week.

GENERAL ELECTRIC sustained a mild boom this week, due to advance reports of the patent deal between the General Electric and Westinghouse Companies, and to the consummation, late Thursday afternoon, of the alliance. The agreement consists substantially of a pooling of patents, of which the General Electric owns 62½ per cent., and the Westinghouse Company 37½ per cent. Each company is to pay a royalty for the use of the patents beyond the proportion represented by its holdings in the pool. The deal seems to have had no effect whatever upon the Westinghouse stocks, and the result was largely discounted by bulls on General Electric, which made a greater advance from Tuesday to Wednesday than after the deal was confirmed, and reacted to-day upon heavy offerings of stock, which had been bought at about 30 and held for the confirmation of the agreement. Several parties, however, who bought large blocks at low figures are holding off for a further advance, which they predict is bound to come. It is argued by friends of the stocks that when the magnitude of the deal and its effect upon the company's profits are fully appreciated, the common stock will be scarce and cheap above 50. A Boston man acquainted with both companies says that the agreement means that 12 per cent. will be easily earned on both of the Westinghouse stocks, and at least 7 per cent. will be earned on General Electric common. He claims that there has not been in five years so important a deal as this one.

THE EDISON ILLUMINATING COMPANY, of New York, reports for February, gross earnings of $195,221, an increase of $18,505 over the same month last year. The net earnings show a gain of $20,754, which means a reduction in cost of operation of $2249, notwithstanding the substantial increase in gross receipts.

THE EDISON ILLUMINATING COMPANY, of Brooklyn, reports gross receipts of $69,419 for February, as compared with $42,412 in 1895, and net earnings after all charges, except dividend of $24,690, an increase of $7393.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	96½	98
" " " Brooklyn	100	110	115
" " " Boston	100	145	150
" " " Philadelphia	100	131	131¼
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	27⅛	28
Electric Storage, pref	100	28½	29
General Electric	100	36⅞	37
General Electric, pref	100	60	62
Westinghouse Consolidated, com	50	31½	31¾
" " pref	50	52	53
BONDS.			
Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	202	202½
American District Telegraph	100	33	40
American Telegraph & Cable	100	91	94
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
Erie Telephone	100	60	61
New England Telephone	100	88½	89
Postal Telegraph-Cable	100	85	86
Western Union Telegraph	100	85	85⅜
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	17½	17¾
Brooklyn Rapid Transit		23¼	23⅞
Brooklyn Traction	100	9½	9
" " pref	100	43	47
Buffalo St. Ry	100	73	77
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	47	50
Hestonville	100	47⅛	47¾
" pref		..	63
New Orleans Traction	100	17	19
" " pref	100	63	66
North Shore Traction	100	30	32
" " pref	100	80	82
Rochester St. Ry	..	28	33
Steinway, Ry	..	49	..
Union Railway (Huckleberry)		99	102
Union Traction, rcts $5 pd	..	15	15⅛
West End, Boston	100	69½	69½
" " pref	100	88	90
Worcester Traction	100	15	17
" " pref	100	88	90
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	79	81
Buffalo St. Ry. 1st con. 5s	100	105	107
Cleveland Elec. Ry. 1st mtge 5s	100	101	103
*Columbus St. Ry. 1st 5s	100	95	100
Rochester St. Ry. 1st 5s	100	98	101
Union Railway (Huckleberry) 1st mtge 5s		103	105½
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, March 16, 1896.

MR. THOS. R. TALTAVALL, who for the past five years has been secretary and treasurer of the Electrical Age Publishing Company, and editor of the *Electrical Age*, has sold his interest in the paper and resigned his position as editor. We are informed that Mr. A. C. Beck, president of the W. C. Vosburg Manufacturing Company of Brooklyn, is the purchaser.

MR. NATHANIEL W. PRATT, president of the Babcock & Wilcox Company, died at his home in Brooklyn, March 10. Mr. Pratt was born in Baltimore in 1852, and at one time was engineer of the Dynamite Gun Company. He was a member of the American Society of Mechanical Engineers, American Institute of Mining Engineers, American Naval Institute and the Engineers' Club of this city.

WASHINGTON NOTES.

WASHINGTON, D. C., March 13, 1896.

A BILL BEFORE CONGRESS authorizing the Kansas City, Pittsburg & Gulf Railroad Company to construct and operate a telephone and telegraph line through the Indian Territory, has been approved.

THE ACT BEFORE CONGRESS which asks for an extension of the time within which the Maryland & Washington Electric Railway Company shall be required to complete the building of its road has been approved.

SEVERAL AMENDMENTS TO THE CHARTER of the Washington & Great Falls Electric Railway Company are included in a bill which Senator Isham G. Harris, of Tennessee, has presented to Congress. One proposes increased service to the Methodist University, another establishes the legality of the bond issue of the company, and a third increases the capital stock to $650,000.

REPRESENTATIVE L. F. LIVINGSTON, of Georgia, has a bill before the House to incorporate the National Capital Gaslight, Heat & Power Company, of the District of Columbia. The company will be required to enter into a bond of $200,000, with sureties satisfactory to the Commissioners, as a guarantee of its faithful compliance with the terms of its charter, and it is prohibited from selling its franchise except to the Government.

THE SUIT OF THE UNITED STATES ELECTRIC LIGHTING COMPANY against the Commissioners has been dismissed. The suit was for an injunction to prevent the Commissioners or major of police from interfering with the relaying of the wires connecting with the Bureau of Engraving and Printing. Attorney Thomas brought in a formal answer to the bill, which included the statement of the Commissioners to the effect that there should be no interference. In dismissing the suit the court placed the costs on the District.

REPRESENTATIVE ELISHA E. MEREDITH, of Virginia, has introduced in Congress a bill which authorizes the Falls Church & Potomac Railway Company to equip and operate a single or double-track railway over its lines, with the necessary buildings, switches, machinery, appliances, and devices necessary to operate the same by cable, electricity, compressed air, storage battery, or other motive power to be approved by the Commissioners, provided that no overhead trolley shall be used, the railway company being required to deposit $1000 with the Collector of Taxes within 60 days from the passage of the bill, as a guarantee that it will commence and complete its road within the specified time, which is given as two years from the date that the bill passes Congress. The Committee on the District of Columbia has the bill under consideration.

REPRESENTATIVE GEORGE L. WELLINGTON, of Maryland, has introduced in the House a bill to permit the Home Telephone Company, of Washington, D. C., to install, maintain and operate a telephone and telegraph plant and exchange in the District of Columbia. The bill was previously introduced by Representative Joe Abbott, of Texas, but has been entirely remodeled so as to obviate, if possible, the objections raised by the Commissioners. The statement is made that the company is incorporated under the laws of West Virginia. The rates proposed to be charged are increased from $25 to $30 per year for residences in Washington, and from $30 to $42 for business houses. After the opening section the Commissioners' subway bill is embodied as the remainder of the bill, with the Home Telephone Company substituted for the contractor and the period of the franchise extended to 50 years instead of 30 years.

THE COMMISSIONERS have made their report on the Senate bill appropriating $100,000 for laying a system of underground conduits within the city limits for the use of private electrical companies and the District, the municipal government to own the conduits and rent spaces to private corporations. In their report on the measure the Commissioners say if the highway act and system of trunk sewers is carried out, the District cannot afford to build these conduits for some years to come. For this reason they recommended in their subway bill that the privilege of laying subways in the streets be rented to the

highest bidder for 30 years, at the end of which time the conduits shall revert to the District. "But whatever is done," the Commissioners say, "to meet the growing demand for electrical conduits and subways, the final aim should be the municipal ownership of them all. If Congress cannot pass our subway bill, we are in favor of beginning the subway system in the manner contemplated in this measure. But not more than $100,000 per annum should be expended and conduits and all overhead wires belonging to the several electrical companies should be placed in them as rapidly as they are constructed. About 62 more miles of conduits are necessary now, and 163 miles more would cover the entire city, at an estimated cost of $2,566,000."

Western Notes.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., March 13, 1896.

THE CHICAGO GENERAL FIXTURE COMPANY is getting out its new 1896 catalogue of supplies and fixtures, which will be ready about April 1 for distribution to the trade upon application.

MR. J. R. WILEY has recently taken several large orders for the Standard Underground Cable Company, including a contract for underground cables, to be used by the Central Union Telegraph Company, at Columbus, O.

BOWERS BROS., 117 Lake Street, have issued a handsome catalogue and standard price list of electrical mica. Mica, both India and amber, and in almost every imaginable form for electrical purposes, is included. The price list is for uncut mica and cut to size, in stamped segments, solid sheet segments, rings, etc.

MR. W. O. MEISSNER, president of the Washington Electric Company, Chicago, reports that business during the past month is showing a decided improvement. The company is making a specialty of theatre dimmers and electrical theatrical appliances. A descriptive catalogue of its many specialties will soon be issued.

MR. W. H. SCHOTT, consulting engineer, 1628 Monadnack Block, has just returned from Vinton, Ia., where he was called by the city to inspect and test the electric light plant that is being installed for them by the Biglow Construction Company. The above plant will probably be accepted on Mr. Schott's recommendation.

TELEPHONE LITIGATION.—The eyes of the telephone world will soon be directed toward Attorney S. S. Stout, of Chicago, who is to argue what by some is considered the first really contested case against the Western Electric Company in telephone matters. This is a suit brought by the Western Electric Company on the well-known Watson patents.

THE ELECTRIC APPLIANCE COMPANY has been fortunate in securing some nice contracts for bare copper wire, acting as Western selling agents for the Taunton Copper Manufacturing Company. The product of this mill is well-known as a particularly high-grade article, and the Electric Appliance Company hopes to make it one of its leading specialties.

K. McLENNAN & CO., manufacturers of the Gates commutator compound, report that heretofore they have been giving their attention to the consumer, and accordingly have created a heavy demand for their compound. They are now establishing distributing agents throughout the United States and Canada. They report that they still have a few vacancies for wide-awake supply houses.

Colorado Notes.

DENVER, COL., March 11, 1896

MAYOR McMURRAY has vetoed the ordinance granting the Denver Tramway Company a franchise to lay tracks for an electric railway on Wynkoop Street from Sixteenth to Eighteenth Streets.

A FRANCHISE for an electric light plant in Gillett, a few miles from Cripple Creek, has been asked for by N. R. Parks, of Chicago. He offers to install a plant to cost $25,000 if a perpetual franchise is granted, and if the city agrees to use a certain number of lamps.

FORTY-THREE COMPLAINTS were sworn to by Mayor McMurray a few days ago in suits against the Denver Tramway Company for its alleged failure to pay license fees on 43 cars operated on its lines. The cars in question are trailers, for the operation of which the company claims it is not compelled by law to pay license fees.

THE COLORADO TELEPHONE COMPANY recently held a meeting in Denver of its representatives from the cities where its exchanges are maintained. It is the purpose of the company to have its agents meet from time to time to exchange views and to discuss questions of policy. E. B. Field, the general manager, made an address to the agents, and matters of interest on the operation of exchanges were discussed.

A RAILWAY to connect Cripple Creek and Colorado Springs is projected by the Colorado Springs, Cripple Creek & Western Railway Company. The company has just been incorporated with a capital stock of $2,000,000 by W. S. Stratton, of the famous Independence Mine, Irving Howbert, William S. Jackson, Frank G. Peck and Thomas H. Edsall. The survey is now in progress. It is stated that the railway may be electrically operated.

THE NORTHERN COLORADO TELEPHONE COMPANY has been incorporated with a capital stock of $25,000 by Thomas J. Montgomery, A. W. Scott and F. J. Annis. The company proposes to build a telephone line along the route of the proposed Port Collins, North Park & Western Railroad Company. The telephone service will extend, it is stated, to Fort Collins, La Ponte, Bellevue, and to other towns as far distant as Hahns Peak.

NEIL McLERTY, superintendent of the electric light plant in Ouray, Col. was caught in a belt in the station recently, and sustained injuries from which death resulted. Mr. McLerty had resigned his position, and was explaining to his successor some points in connection with the machinery, when the accident occurred. He was formerly chief electrician of the Rapid Transit Company of Colorado Springs, and was highly esteemed. He leaves a wife and two children.

THE ARNOLD ELECTRIC POWER STATION SYSTEM has been adopted by the Chicago Board of Trade for a 300-hp plant, and by the Suburban Railway Company, of Chicago, for a 1000-hp plant. This it will be remembered is the system which allows the engines and generators to be directly coupled, but makes any generator available from any engine, thus giving the advantages of a belted plant. The Arnold Electric Power Station Company of 1540 Marquette Building, controls the system.

ROENTGEN RAYS.—During the last few days Dr. C. E. Tennant, Jr., and H. H. Buckwalter, of Denver, have succeeded in securing satisfactory negatives by means of the Roentgen rays, by using a lead glass tube made by the Diamond Incandescent Lamp Company, of Denver. In order that no mistake could be made about the quality of the glass it was analyzed. It was demonstrated that with four minutes' exposure a negative of the hand, showing all the bones from the finger tips to the wrist, could be secured.

THE UNION RAILWAY COMPANY of Denver has just been formed. The company will be affiliated with the Denver City Cable Company. The new organization will apply to the city authorities for a franchise from the Union Depot along the line of the Denver City Cable to Clarkson Street, and thence to the southern limits of the city and for a franchise for a line from the Union Depot along the West Denver Cable route to Fourth Avenue and thence on Fourth Avenue, South Tremont Street, Second Avenue and Sherman Avenue to the city limits. The company proposes to use electric power, and it will apply for the right to change the motive power of some of the cable lines to electricity by an agreement with the Denver City Cable Company. It is proposed to pay the city 3 per cent. of the gross receipts as consideration for the franchise.

THE COMMITTEE ON ELECTRIC LIGHTS recently appointed by Mayor McMurray to determine whether the arc lamps furnished by the Denver Consolidated Electric Company were giving the amount of illumination required by contract has submitted its report. As stated in a previous letter, the charge was made by a local paper that the city was being swindled by the electric light company inasmuch as its lamps did not furnish 2000 candle-power each. Thomas B. Stearns, Prof. E. Bethel and Prof. W. D. Engle were selected by the Mayor to investigate the matter. Their findings, as would naturally be supposed, exonerated the company. They report that the lamps in service are of the size specified in the contract, and are the same as those used in other cities, and designated as 2000 candle-power. They suggest that the photometric test be discontinued and that in future contracts for arc lights specify a certain size of lamp consuming 450 watts and using certain makes of carbon, and that the contract should contain a clause providing for the testing of the lamps by a properly standardized wattmeter.

English Notes.

(From Our Own Correspondent.)

LONDON, March 4, 1896.

THE LIGHTING OF THE CITY OF LONDON.—At a recent meeting of the shareholders of the City of London Electric Lighting Company the chairman stated that applications for connections continue to come in at the rate of about 1000 8-cp lamps per week, and he anticipated that by the end of the present year they would have at least 250,000 lamps connected, exclusive of arc lamps.

THE GOVERNMENT AND THE TELEPHONES.—Last week, in answer to a casual question a member of the government made, in a casual manner, a most important announcement with regard to the policy of the government vis-a-vis the National Telephone Company. The announcement was to the effect that the government did not propose to purchase the business of that company until the expiration of its license, which is due to take place on Dec. 31, 1911.

CENTRAL LONDON RAILWAY.—A meeting of the shareholders of this company was held last week, but no information of particular interest was forthcoming. The actual work of boring has not yet begun, but the chairman stated that very shortly the work of excavating the whole of the open space in front of the Mansion House, Bank of England and Royal Exchange would be commenced. Upon this spot, as perhaps your readers may recollect, several projected electric lines converge, and it is intended to have a joint underground station to be used by some three or four electric railway companies.

ELECTRICAL MATTERS IN PARLIAMENT.--The total number of applications for electric lighting franchises in England, Ireland and Wales which have come before Parliament this session amounts to 38, the capital for carrying out these schemes being placed at 1¼ millions sterling. There are also 22 railway bills, which relate to the construction of over 100 miles of railway and to the raising of capital to the extent of 2½ millions sterling, in more than half of which the adoption of electric traction is contemplated. In addition to the bills, there are also 15 railway provisional orders asked for, in nine of which electric traction is specifically mentioned.

THE THREE-WIRE PATENT.—The time for entering in "caveats" or announcements of opposition to the petition for the prolongation of the Hopkinson three-wire patent expired on Monday, Feb. 24. At that date three corporations and one electric supply company had performed the necessary formality, but the opposition to the extension of the term of this patent is, I believe, more pronounced than the numbers here stated would lead one to suppose. Of course it is natural that owners of three-wire systems should wish to exempt themselves from the very modest tribute of £2 10s. per ton of copper per annum which is levied upon them by the Westinghouse Company, especially when, in some cases, this amounts to something like £750 to £1000 per year. But apart from such purely financial considerations as these, I do not think there is any reason why the electrical industry should excite itself overmuch even if the patent be prolonged for as long a period as seven years, since it is undoubtedly a good patent, and the owners of it have not insisted too ruthlessly upon their pound of flesh.

LIGHT RAILWAYS.—Last session Mr. Bryce, president of the Board of Trade under the late Liberal Government, after hearing the views of all concerned at a light railway conference, introduced a bill to facilitate the construction of

such lines, but true to his Liberal principles, emphatically vetoed any granting by the State of loans in aid. The bill shared the fate of the Government which proposed it and disappeared. This session Mr. Ritchie, president of the Board of Trade under the Conservative Government, has introduced much the same sort of bill, but with the important addition that State 3½ per cent. loans in aid to the extent of one million sterling are contemplated. It is needless to say that the agricultural interest is in loud praise of this financial sop, and that the economists of the old school are equally loud in their denunciation of this introduction into England of what they consider to be a pernicious system of State doles. The bill, however, has been read a second time without a division, and bids fair to become, in due course, one of the many laws of the land. As a few millions will thus inevitably be spent in the next few years on the construction of rural railways, the electrical industry, at any rate, may regard the economic heterodoxy of the present president of the Board of Trade with comparative equanimity, since it will probably result in a large stream of orders to makers of motors, railway generators, car-gearing and other electro-mechanical accessories.

General News.

NEW INCORPORATIONS.

THE NEW YORK ELECTROLYSIS COMPANY, Chicago, Ill., has been incorporated with a capital stock of $500 by Henry P. Fitzpatrick, Edgar L. Jayne, and Amon W. Martin, for the purpose of using the electric needle in removing blemishes.

THE KEWANNA LIGHT & IMPROVEMENT COMPANY, Kewanna, Ind., capital stock, $15,000, has been formed by J. T. Urbin, E. P. Washburn, E. A. Elston and J. H. Wilson, for the purpose of furnishing electric light in the town of Kewanna.

THE FAIRMOUNT TRACTION COMPANY, Richmond, Va., has been formed by S. H. Pulliam, J. H. Dinneen, W. T. Heckler, W. J. Westwood, F. C. Brauer, Jr., Richmond, for the purpose of building and operating street railways. Capital stock, $100,000.

THE SALEM-BLACKSBURG ELECTRIC RAILWAY COMPANY, Salem, Va., capital stock, $300,000, has been organized by J. W. F. Allemong, E P. Willson, C. P. Kanode, J. C. Langhorne and James Chalmers for the purpose of building and operating street railways.

THE ETNA ELECTRIC COMPANY, Pittsburg, Pa., has been incorporated with a capital stock of $1020 for the purpose of supplying electric light, heat and power. Those interested are Charles H. Bradley, Pittsburg; C. H. Bradley, Pittsburg, and Robert Wardrop, Sewickley.

THE LAKE & GEAUGA TRANSIT COMPANY, Chardon, O., has been formed by S. S. Smith, H. H. Hollenbeck, William G. King, C. W. Osborne and H. M. Wells, for the purpose of constructing and operating an electric railway in Lake and Geauga Counties. Capital stock, $10,000.

THE W. S. GRIFFITH COMPANY, Trenton, N. J., capital stock, $20,000, has been formed for the purpose of manufacturing and selling electrical and mechanical appliances of all kinds. Among those interested are Charles S. Solomon, Somervell Solomon, Philadelphia, and Wilfred S Griffith, Amber, Pa.

THE NORFOLK ELECTRIC LIGHT & POWER COMPANY, Norfolk, Va., has been incorporated by Paul K. Browd, B. N. Sperry, George Russell, Walter H. Taylor, Norfolk, Va., and J. C. Sperry, Syracuse, N. Y., for the purpose of erecting and operating electric works of all kinds. Capital stock, $300,000.

THE HELEN GOLD MINING COMPANY, Spokane, Wash., capital stock, $600, 000, has been incorporated by T. D. Rockwell, W. J. Collins, W. C. Drury, J. C. Haas, W. J. C. Wakefield, Andy Symons and Charles Dawson, for the purpose of doing a general mining, smelting, milling, reduction and electric light business.

THE LANCASTER TRACTION COMPANY, Lancaster, O., has been organized by Andrew Bauman, George Matt, Irvin Butterworth, Frank T. Stewart and Harry R. Beeson for the purpose of constructing, acquiring and operating street railways to be operated by electricity, steam or other power. Capital stock, $100,000.

THE MILLHEIM ELECTRIC TELEPHONE COMPANY, Millheim, Pa., has been formed for the purpose of erecting and maintaining a telephone line and leasing and putting in telephones in private and public places. Those interested are W. L. Goodhart, Millheim, Pa.; J. Spiglemyer and A. Walter, also of Millheim. Capital stock, $3000.

THE ELECTRO-CHEMICAL MANUFACTURING COMPANY, Jersey City, N. J., capital stock, $1,000,000, has been formed for the purpose of manufacturing and producing metals preferably by the aid of electricity. Those interested are Ludwig K. Bohm, George W. Vaillant, New York City, and Charles N. King, Jersey City, N. J.

THE SCHROON LAKE & CROWN POINT TELEPHONE COMPANY, Schroon Lake, N. Y., has been formed with a capital stock of $4000, for the purpose of constructing, owning, using and maintaining an electric telephone line. Among those interested are John Rooney, W. L. Bentley, F. A. Griswold, C. H. Wilson, H. E. Denin, all of Schroon Lake, N. Y.

THE WINONA RAILWAY & LIGHT COMPANY, Winona, Minn., has been incorporated by Frank B. Kellogg, C. A. Severance, St. Paul, Edward Lees, Winona, and Frank A. Seymour, St. Paul, for the purpose of building, acquiring and operating street railways and electric lighting plants in the city of Winona, Minn. Capital stock, minimum, $500; maximum, $200,000.

THE DARBY, LANSDOWNE & PHILADELPHIA ELECTRIC STREET RAILWAY COMPANY, Chester, Pa., has been organized for the purpose of building an electric street railway in the town of Darby, Delaware County, Pa. The promotors are William Simpson, Jr, W. P. Simpson, Overbrook, Pa., and George D. Howell, Chester, Pa. Capital stock, $36,000.

THE ST. PAUL & SUBURBAN RAILWAY COMPANY, St. Paul, Minn., has been incorporated in West Virginia by Emerson W. Peet, Ambrose Tighe Frank B. Kellogg, Charles W. C. Withee, St. Paul, for the purpose of owning, building and operating street and electric railways in the counties of Ramsey and Washington, Minn. Capital stock, minimum, $500; maximum, $200,000.

THE POTOMAC RIVER POWER COMPANY, Alexandria, Va., capital stock, $3,000,000, has been incorporated by R. L. Williams, Richmond, Va.; R. W. Moore, B. F. Mackall, Fairfax; E. L McClellan, Alexandria, and H. S. Cummings, Washington, D. C., for the purpose of operating and developing the water-power of the Potomac River for electric, hydraulic, pneumatic and steam purposes.

THE NORTH JERSEY CONSTRUCTION & LAND IMPROVEMENT COMPANY, Hackensack and Passaic, N. J., capital stock, $100,000, has been formed by Alfred Speer, Passaic, N. J.; David A. Pell, Saddle River; Samuel Taylor, Hackensack; and John B. Lozier, Oradale, N. J., for the purpose of constructing or repairing railways, roads, water, gas and electric works, tunnels and bridges.

THE BONHAM ELECTRIC RAILWAY, LIGHT & POWER COMPANY, Bonham, Tex., capital stock, $25,000, has been formed for the purpose of operating street railways and belt lines, manufacturing and supplying electric light and power and constructing and maintaining telephone lines. The promoters are H. C. Alexander, William Lanius, Edward D. Steger, J. W. Peeler, T. E. Kennedy, R. J. Abernethy and J. B. Russell.

TELEGRAPH AND TELEPHONE.

LARAMIE, WYO.—It is reported that a telephone line will at once be constructed from the Table Mountain mines to Laramie.

LEWES, DEL.—A movement is under way for the establishment of a telephone line to connect the railway station at Lewes with points in the town.

SIBLEY, IA.—The Sibley Town Council has granted the Spirit Lake Telephone Company a ten-year franchise. A movement is on foot to secure electric lights.

BODEGA, CAL.—J. W McCaughey, of Bodega, states that a movement is on foot to effect a telephone communication between Bodega and Santa Rosa with a district office at Freestone and one at Sebastopol. The distance is 18 miles.

BAY CITY, MICH.—The Valley Telephone Company, a competitor of the Bell in the Saginaw Valley, has secured over 300 subscribers in this place and 400 in Saginaw. Work on the exchange will soon be commenced.

METROPOLIS, ILL.—Fred B. Curtis has secured a franchise to erect and maintain a telephone exhange. He desires to receive prices for equipments, and expects to have the plant in operation at an early date. One hundred telephones will be put in at the start.

ASHTABULA, O.—The Union Electric Company has been granted a telephone franchise and will compete with the Central Union Telephone Company, already established in Sibley, Ia. The Town Council has granted a 10-year franchise to the Spirit Lake Telephone Company.

WHITESBURG, KY.—Citizens of Whitesburg and Letcher County met at the Court House in Whitesburg recently and endorsed the Big Stone Gap, Va., telephone enterprise. They pledge their support to the company for the erection of a telephone line at once from Whitesburg to Stonega, a mining town 10 miles from Big Stone Gap and 16 miles from Whitesburg.

YPSILANTI, MICH.—The Washtenaw County Telephone Company has been organized with a capital stock of $25,000, and will establish telephone exchanges in Ann Arbor, this city, and elsewhere in the county. It agrees that the rates to consumers shall not be more than $15 for residences and $25 for business places. These are about half the present Bell rates.

KNOXVILLE, TENN.—Mr. J. C. Duncan will hereafter devote his entire attention to the business of the People's Telephone & Telegraph Company, of which he is now general manager. Mr. Duncan has just brought to a close the receivership of the Knoxville electric railway and local electric lighting companies, these properties, through his connection with them, having again been placed upon a good footing.

ELECTRIC LIGHT AND POWER.

APPLETON, WIS.—The Council will open bids for street lighting in May.

NORWOOD, N. Y.—Mr. B. A. Babcock will, it is rumored, erect a central station.

CONCORD, N. C.—It is proposed to issue bonds to buy the local electric light plant.

ARCTIC, R. I.—The question of lighting the streets by electricity is being discussed here.

VIRGINIA, MINN.—The Council is discussing the matter of purchasing the water and light plant.

CAMBRIDGE, O.—The Council has ordered the Clerk to advertise for bids for an electric light plant.

DECORAH, IA.—At the city election it was decided by 500 majority to put in a municipal electric plant.

WOOSTER, O.—The City Council is considering the advisability of buying an electric light plant for the city.

PORTLAND, MICH.—A recent proposition to bond the village $15,000 for electric lights and dam was carried.

DEXTER, MICH.—A new board was elected at a recent election favorable to electric lights and other improvements.

HART, MICH.—The village has voted to bond for $18,000 for electric lights and water-works. C. B. Stevens is president.

LYONS, N. Y.—The Lyons Electric Light & Power Company has been granted a five years' extension of its franchise

NILES CITY, MONT.—Seventeen thousand dollars in bonds has been issued for the purchase of the local electric light plant and water-works system.

FRANKLIN, LA.—The town is installing an electric lighting plant. A 750-light alternator is being installed under the direction of Mr. J. F. Shelton.

MADISON, WIS.—At the meeting of the State Board of Control, to be held here March 25, bids will be received for an electric light plant to be put in the State Prison.

BLAUVELT, N. Y.—The Village Improvement Society expects to have that village lighted by electricity as soon as possible. Power will be secured from S. R. Bradley's factory at Orangeburg.

EMMETSBURG, IA.—At the city election, the question of granting a 20-year franchise for an electric light plant was carried by a large majority. It is likely that a plant will be put in very soon.

LAMBERTVILLE, N. J.—The Hunterdon Electric Company have recently purchased a 100-hp Ball engine from the Parker Engine Company, of Philadelphia, representatives of the Ball Engine Company, of Erie, Pa.

NORTH ADAMS, MASS.—Some local capitalists are considering the project of converting power from the waters of Howe's Pond, near Reedsboro, Vt. into electrical energy and transmitting the same to this city, a distance of 10 miles.

WOODBURY, N. J.—Moore Bros. are contemplating the erection of an electric light plant to light their factory, yard and store. It is possible that it may be extended to the lighting of the streets, churches and other buildings in the borough.

LAFAYETTE, LA.—The contract for the municipal electric light and water-works plant has been given to the New Orleans Railway & Mill Supply Company. Direct-current dynamos of 500 lights capacity, two units in all, are to be installed.

KINGSTON, N. Y.—John Gillie, of the Winiford Park Association, has been in New York to confer with representatives of a syndicate which desires to locate a factory at Winiford Park, and also secure the use of the Glenerie Falls for power for a proposed electric plant.

CHICAGO, ILL.—Sealed proposals will be received March 23 for the construction and installation of the operating machinery and electrical equipment for the North Halsted Street bridge over the north branch of the Chicago River, according to plans and specifications on file in the office of the Department of Public Works.

NORFOLK, VA.—A charter has been granted to the Manaos Electric Light Company to establish electric light plants in the United States and other countries, especially in the City of Manaos, United States of Brazil. Robert D. Evans and Wm. M. Irvine, of New York; William A. Young and James W. Wilcox, of Norfolk, are interested.

CARROLLTON, ILL.—Mr. C. P. Woodworth, on Feb. 14, received a 10-years' franchise for an electric lighting plant, and a contract for five years for electric lights. The contract calls for 35 arc lamps at $60. The commercial lighting will comprise about 1000 incandescent lights. Through an error a note in our issue of March 7 credited the above to Whitehall, Ill.

ELGIN, ILL.—At a creditors' sale, W. J. Ferris, of Cedar Rapids, Ia., purchased the plant of the Elgin Electric Illuminating Company, formerly the Dundee Rapid Transit Company, which assigned some time ago. He did not buy the franchise, and may operate the plant here or he may remove it.

ITHACA, MICH.—The Ithaca Light & Power Company was organized at the office of Stone & Salter. The former electric lighting company suspended business. The new company has purchased the plant of the redeeming creditor and will operate it. The capital is $15,000, and the officers are: President, D. T. Covert; vice-president, C. E. Webster, and secretary, James B. Crawford.

SALT LAKE CITY, UTAH.—The Pioneer Electric Company has been incorporated with a capital stock of $2,000,000. The officers are G. Q. Cannon, president; J. R. Winder, vice-president; and C. K. Bannister, secretary and treasurer. The object of the company is the acquirement, storage and utilization of the waters of the Ogden River and other streams for the generation of power, and the acquirement of franchises for electric lighting, etc.

TRENTON, N. J.—The New Jersey & Pennsylvania Power Company has bought the island in front of Morrisville and the waterway that divides it from that borough, with the right to build a wing dam in the Delaware River for the purpose of generating electricity and selling it to mills, factories and electric railways. The incorporators are Gen. William S. Stryker, Col. A. R. and John Kuser. The capital stock of the company is $100,000, but only $1000 has been paid in.

BRONSON, MICH—Rheubottom & Bond, of Union City, have completed a central station plant here and turned it over to the Bronson Electric Company. This plant is a decided novelty in this section, power being supplied from a gasoline engine. The lights are pronounced unusually good, both arc and incandescent being in operation. The engine was furnished by the Otto Gas Engine Works, Philadelphia, and the dynamos by the United Electric Improvement Company, of the same city.

MADISON, IND.—Sealed proposals will be received April 8 for the furnishing and construction of a new electric light plant. The successful contractor is to receive a contract for lighting the streets for a term of 10 years, with from 100 to 125 arc lamps of 2000 candle-power. He is also to build, construct, equip and operate approximately three miles of electric street railway and receive a franchise therefore of 30 years. Plans and specifications are now on file in the City Clerk's office, and at the office of Messrs. Pierce & Richardson, Manhattan Building, Chicago, Ill., consulting engineers for the City of Madison. George B. Clark is City Clerk.

RICHFIELD SPRINGS, N. Y.—In our issue of March 7 it was stated that the works of the electric light and power company of this place had been burned without any insurance. We learn, however, that but two of the upper stories of the building, in which the electric light plant is located, were burned out, and that while the belts and machinery of the electric light plant were damaged, the loss was not over $2000. The arc lights were running the second night after the fire, and the incandescent lights the night following. The building has been roofed over and is now but one story high, and with no other occupant than the electric lighting company.

The Electric Railway.

TAMPA, FLA.—The extension of the street railway at this place is under consideration.

WINCHESTER, MASS.—A petition in favor of an electric road on the West Side has thus far received 70 signatures.

PORTSMOUTH, VA.—M. W. Mason's application for building an electric street railway in the city will come up before the Council soon.

MARION, N. Y.—The citizens of Marion will hold a meeting to consider the question of constructing an electric road from that village to either Palmyra or Newark.

ST. GEORGE, S. I., N. Y.—Preparations are being made by the two electric railway companies in Staten Island which have been granted franchises here to begin the laying of their tracks as soon as the weather permits.

ST. MARY'S, O.—The stockholders of the Sidney Electric Railway here elected H. T. Mathers president. This company is incorporated with a capital of $100,000, and will build an electric road between Sidney and St. Mary's.

TOWANDA, PA.—In our issue of March 7, a note giving the names of the creditors of the Bradley County Railway Company, erroneously located that road in Tonawanda, Pa., there being no town of that name in Pennsylvania.

CARLISLE, PA.—Ex-Judge Sadler, representing a syndicate, has applied for a franchise to build an electric street railway in Hagerstown, Md. He agrees to begin work on the road 10 days after the franchise is granted, and to put up a $10,000 bond as a guarantee.

MONTREAL, QUE.—The Lachine Rapids Hydraulic & Land Company will receive proposals until the 25th inst. for generators, etc., necessary for the transmission of about 16,000 horse-power. Address W. McLea Walbank, managing director, 214 St. James Street

CHATHAM, ONT.—The Chatham City & Suburban Railway Company are seeking incorporation to construct an electric railway through the city to a point near the Raleigh and Norwich town line at Lake Erie, with a branch through the township of Dover to the town of Petrolea.

FREEPORT, ILL.—The General Electric Company proposes to make extensive improvements during the Spring and Summer. The company proposes to expend between $30,000 and $40,000 on the line, for which purpose the capital stock was increased $25,000 and the money was paid in at the December meeting of the Board of Directors.

COLUMBIA, S. C.—A bill has passed both houses of the General Assembly to allow the people of Brookland to build an electric car line. A company composed of residents of both Columbia and Brookland has been organized and all the stock taken, and it is their purpose to build a line from the Richland side of the river across the bridge and through the town of Brookland to Horseshoe Lake, in Lexington County.

SHELBURNE FALLS, MASS.—The stockholders of the Shelburne Falls & Colrain Street Railway Company have effected a permanent organization with the following officers: President, David W. Temple; vice-president, Lorenzo Griswold; treasurer, Herbert Newell; clerk, Clifton L. Fields; directors, the officers, and Edwin Baker, C. A. Marcy and Freeman L. Davenport. The road will connect the villages of Shelburne Falls and Colrain, and will cost $85,000.

THE VICTORIA ELECTRIC RAILWAY & LIGHTING COMPANY, Limited, of Victoria, B. C, is advertised for sale under mortgage foreclosure. The sale will take place on April 12 next in the City of Victoria. The property consists of a fully equipped electric railway consisting of 13 miles of track; also a fully equipped electric lighting plant with a capacity for supplying 4650 16-cp lights and 45 arc lights. The debenture holders are the Right Hon. William Brabazon, Lindsay Toler, Earl of Norbury, William Fuller Maitland and John Horne-Payne, Q. C.

NEW ORLEANS.—The Claiborne Street Subway Company has placed contracts for an equipment to change from mule to electric traction. The General Electric Company will furnish the electrical apparatus, which is to consist of two 300-kw generators and switchboard, and 30 double G. E.-800 motor equipments. The E. P. Allis Company will furnish the engines, and the Edgmore Iron Company, of Edgemore, Del., the boilers. The cars are to be from the American Car Company, of St. Louis, and are to be equipped with Lord Baltimore trucks. The work of equipping the road will proceed at once. This is the last mule line in New Orleans, and its equipment electrically means the disappearance of the car mule entirely from the streets of New Orleans.

Trade and Industrial Notes.

A. O. SCHOONMAKER, 158 William Street, New York, in order to meet the wants of his customers, is now building up his solid sheet mica segments and washers to required thickness, ready for use.

I. P. FRINK, 551 Pearl Street, New York, has supplied for the art gallery in the mansion of Mr. Charles T. Yerkes, New York, a series of reflectors and electroliers combined, which thoroughly light the pictures from one circuit and the gallery from the other.

THE SHAWMUT FUSE WIRE COMPANY, 93 Federal Street, Boston, Mass., has issued a new "1896" catalogue of fuse wires. Among the new matter included is a table of fuses to be used in standard cut-outs, which will be of much assistance to purchasers in ordering.

THE NOWOTNY ELECTRIC COMPANY, Cincinnati, O., is preparing to put on the market some new articles to be used in connection with electric lighting. The articles referred to will be ready for dealers in 30 days, and are described as something entirely new and abreast of the times.

THE GARLOCK PACKING COMPANY, of Palmyra, N. Y., and Rome, Ga., reports a large increase in business during the past few months, necessitating running its factories overtime. On account of the continued increase in demand for its various packings, a large addition is being built to its factory buildings at Palmyra, N. Y.

BI-METALLIC WIRE.—The Bi-Metallic Electric Wire Company, Havemeyer Building, New York, in a neat circular sets forth the advantages of bi-metallic wire for telephonic and other uses. J. A. Roebling's Sons Co., of Trenton, N. J., now manufacture this material, which is sufficient assurance as to its quality and workmanship.

THE TRADERS' PAPER COMPANY of Lockport, N. Y., ask for bids on plans and specifications for a 200-light plant for themselves and a 150-light plant for the Niagara Paper Company of the same city. Each plant must have independent engines to run them. The plans and specifications will be ready for inspection on Friday and Saturday, March 20 and 21.

PAUL C. ANTHONY, Reading, Pa., has entered business as an electrical engineer and dealer in electrical supplies. Mr. Anthony for four years was chief operator for the Pennsylvania Telephone Company, and he starts out with a contract for supplying specifications and superintending the wiring for more than 200 incandescent lights in the Berks County jail.

THE BERLIN IRON BRIDGE COMPANY of East Berlin, Conn., is very full of work and is running its entire plant with a full force of men. It reports contracts lately completed for electrical companies as follows: New car house, engine room and boiler house for the Bergen County Traction Company at Fort Lee, N. J.; new power house and boiler plant for the Hackensack Gas & Electric Company at Hackensack, N. J., and a new car shed building for the Third Avenue Railway Company, at Harlem River, N. Y.

RAYMOND, STEARNES & GRAY is the name of a new firm of electrical contractors and manufacturers' agents which has been formed in New Orleans. Mr. Alfred Raymond, formerly superintendent of the Edison and Louisiana Light Companies, and Mr. R. S. Stearnes, formerly sales manager of the So. Elec. Mfg. & Supply Company and Mr. V. Gray are the partners. In addition to acting as contractors and agents, this firm also manufactures telephones and is prepared to furnish an excellent Hunnings transmitter 'phone.

HYDRAULIC JACKS.—The W. & S. Hydraulic Machinery Works (Watson & Stillman) 204-210 East 43d Street, in a 38-page catalogue illustrate and describe a large number of hydraulic jacks of many different types. Among these are included the well-known Vreeland transfer pit jack which is largely used by electric railway companies for handling electric motors in the pit. A number of forms of screw jacks are also illustrated and described. All of the illustrations in the book are wood cuts or line engravings, thus enabling the various details of the jacks to be clearly appreciated.

W. F. KILLION & CO., electrical contractors and manufacturers of motors, dynamos and telephones, of 1213 and 1215 Filbert Street, Philadelphia, have just completed the construction of a 50-drop telephone exchange for Wm. Cramp & Sons' Ship & Engine Building Company. The system is metallic throughout, hard drawn, copper-covered wire being used. The calls average from 100 to 150 per hour during the morning. All batteries are placed in the exchange. They have also placed 280 pairs, connecting offices and store houses in Philadelphia; a 250-drop exchange at Hanover, Pa., and a 50-drop exchange at Cape May, N. J.

THE F. J. PEARSON MANUFACTURING COMPANY, Security Building, St. Louis, Mo., has recently brought out a line of new electrical appliances, among which is an improved dry battery known as "The Hang-up Dry Battery." Among the principal features claimed for this battery is the provision for hanging up, which practically does away with the necessity for shelves or boxes. It is convenient to install, is out of the way and cannot upset, thus avoiding an endless amount of trouble. The square form of this battery admits of great convenience in packing for shipment, etc. The manufacturers anticipate a growing demand for these batteries, especially as they claim to be in a position to put them on the market for a much less price than is asked for other dry cells.

CORNELL UNIVERSITY WINS A PRIZE.—Cornell University has been declared the winner of the prize lathe offered by the Davis & Egan Machine Tool Company to the most popular technical or mechanical school in the United States. This lathe is the "Silver Plated Tool Room Lathe" that attracted so much attention at the World's Fair in Chicago, and which, besides being beautiful, is capable of doing as much work as any tool of the kind made. Cornell has a total of 95,818 votes to her credit. The Jewish Manual Training School, of Cleveland, follows with a vote of 85,000, and the Cincinnati Technical School comes in third with 68,060 votes. Among the schools interested in the contest were the Massachusetts School of Technology, Armour Institute of Chicago, Stanford University of Stanford, Cal.; Pratt Institute of Brooklyn, N. Y.; Michigan State University, and in fact, all of the schools of any importance in the country. The total number of votes cast amounted to over 1,000,000. The machine is now at the Chicago branch of the Davis & Egan Company, but will be shipped to Cincinnati and exhibited here before being shipped to Ithaca.

Business Notice.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 10, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

555,922. INSULATING SUPPORT FOR BOXES CONTAINING ELECTRICAL APPARATUS; T. H. Brady, New Britain, Conn. App. filed Jan. 4, 1896. A metallic box, containing a cut-out or other electrical apparatus and provided with projecting lugs having curvilinear recesses opening away from the box, and from each other, in combination with insulating knobs having necks which are hugged by said lugs, and holding the box in a position of separation from the object to which such knobs are fastened.

555,937. CONDUIT RAILWAY SYSTEM; O. A. Enholm, New York, N. Y. App. filed June 15, 1895. In a conduit railway system yokes having transverse arms adapted to receive the rails, and laterally-arranged plates in line with the conduit openings through the yokes, the plates being U-shaped in cross-section and having their ends adapted to fit together, the transverse arms of the yokes being arranged substantially midway between the opposite ends of the said laterally-arranged plates.

555,938. INDIVIDUAL CALL SYSTEM FOR AUTOGRAPHIC TELEGRAPHS; H. Etheridge, Pittsburg, Pa. App. filed Feb. 1, 1892. In combination with a clockwork mechanism connected to a feed roll of a paper feed mechanism of a revoluble and magnetizable shaft and a magnet directly co-operating therewith.

555,958. TRAVELING CONTACT DEVICE; M. D. Law, Washington, D. C. App. filed Sept. 28, 1894. A traveling contact device for electric railways comprising a trolley wheel or part which travels in immediate contact with the line conductor, a pivoted arm for supporting the same consisting of horizontally and vertically arranged parts connected by a transverse pivot, said trolley-wheel or contact piece being located vertically above the pivot and springs applied to lift the horizontal part and to maintain in upright position the vertical part of the arm.

555,959. UNDERGROUND TROLLEY; M. D. Law, Washington, D. C. App. filed May 9, 1895. A trolley device comprising a trolley leg provided at its lower end with a base, consisting of a longitudinal bar in insulating material provided with a crosshead at its end, a horizontal vertically-yielding supporting arm attached at one end to said crosshead, a vertical trolley arm pivoted on said supporting arm and swinging in a vertical plane, and oppositely acting springs applied to said vehicle arm and tending to maintain the same in vertical position.

555,963. DYNAMO-ELECTRIC MACHINE; W. M. Mordey, London, England. App. filed April 21, 1891. In a dynamo-electric machine a stationary non-magnetic armature having an annular series of coils, and two series of rotating magnetic poles at opposite sides of said armature-coils.

555,968. ELECTRIC GAS-LIGHTING BURNER; J. A. & G. A. O'Neill, Boston, Mass. App. filed Nov. 16, 1895. In an electric gas-lighting burner, in combination with a body and a rotating burner pillar, a movable electrode rod rigidly attached to the movable collar, a spring electrode, a spring, a plate-piece, a key and devices for connecting the key with the movable burner pillar, and a part having a surface and a fixed electrode.

555,979. ELECTRIC ELEVATOR; H. R. Smith, Chicago, Ill. App. filed March 23, 1895. In an electric elevator, a car, a hoisting cable therefor, a magnetic piece suspended from said cable, a motor, comprising a solenoid, said magnetic piece forming the core of the solenoid and means for energizing said solenoid.

555,984. SELECTING AND OPERATING TELEPHONES; H. L. Webb, New York, N. Y. App. filed March 18, 1893. In a selective telephone system a single line on which is placed a telephone, and a single line on which is placed an impulse-transmitting instrument, and a selecting instrument at each of the stations, means operated by each of the selectors in response to impulses from any one of the transmitting instruments over the selector line to thereby bring into circuit and connect the communicating telephones with each other.

555,992. ELECTRIC METER; C. Wirt, Philadelphia, Pa. App. filed Nov. 30, 1894. In an electric meter, the combination of an electric motor for driving a register, said motor oscillating continuously when current is passing through the meter, and means controlled by current indicator for controlling the arc of vibration of said motor whereby the movement of the motor is made proportional to the current to be measured.

556,007. AUTOMATIC TELEPHONE EXCHANGE SYSTEM; M. Freudenberg, Paris, France. App. filed Jan. 10, 1896. In a switchboard system for automatic intercommunication, the combination with a number of subscribers' lines of carriages, one for connection with each of said lines, switchboards or contact-plates at the central station of less number than the number of subscribers, each switchboard having contacts for all of the subscribers' lines—such as beams—in electrical connection with the switchboards, and with which the carriages are adapted to make contract to complete the circuit to the switchboard.

556,027. SECONDARY BATTERY PLATE; I. Samuels, New York, N. Y. App. filed Sept. 10, 1894. In a secondary battery, a positive element and a negative element each having an equivalent amount of material, the negative element being in two equal portions and arranged on opposite sides of the positive element.

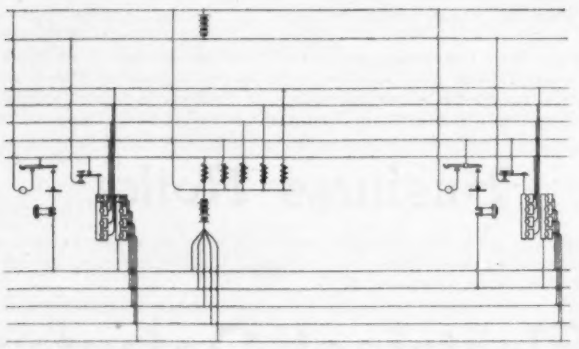
556,028. CIRCUIT BLOCK; D. A Schlutt, Peru, Ind. App. filed Nov. 16, 1895. A circuit block for use in making branch electrical connections consisting of two or more sections of insulating material secured together by one or more metallic connections attached to each other, such metallic con-

nections having electrical connections with main feed and branch wires respectively.

556,034. TELEPHONE SPEAKING-TUBE SYSTEM; J. S. Stone, Boston, Mass., and G. K. Thompson, Malden, Mass. App. filed Sept, 28, 1895. A polarized call bell consisting of a hollow metal casing open at both ends with a bar across one end, a permanent magnet enclosed in said casing and secured by one pole to the said bar, an electromagnet within the casing between the poles of the permanent magnet, and secured to the under side of the bar, having attached to its free end a pivoted armature and a circuit-breaker, the armature carrying a bell-hammer which extends through the casing into proximity with a gong secured thereto. (See Illustration.)

556,046. RAIL-BOND FOR ELECTRIC RAILWAYS; F. H. Daniels, Worcester, Mass. App. filed June 26, 1895. In a rail-bond, the combination with the two terminals or ends, consisting of a head of cylindrical shape into which the end of the bond-wire extends, the other portion also of cylindrical shape and extending at right angles to the head and provided with a central opening extending through it to receive the drift-pinof a bond wire secured at its ends to the terminals.

556,072. ELECTRIC SIGNALING SYSTEM FOR RAILWAYS; G. L. Thomas, Brooklyn, N. Y. App. filed June 11, 1895. In combination, a track-section having its rails insulated from adjacent track-sections, the adjacent track-sections each having their rails in electric circuit with a relay, the one with a relay at a signal-tower at one end of the intermediate track-section and the other with a relay at a signal-tower at the opposite end of the intermediate track-section, a signal-controlling electromagnet at each of said towers and electric circuits including the rails of the immediate track-section, the armatures of the said relays and a second relay at each of said towers for permitting or preventing the operation of the signals at the towers according to the position or positions of a train or trains on said track-sections.



No. 556,034.—Telephone Speaking-Tube System.

556,079. ELECTRIC CAR LIGHTING SYSTEM; A. H. Armstrong, Schenectady, N. Y. App. filed May 31, 1895. In combination, a three-phase railway line, electrically-propelled vehicles thereon, one of such vehicles making traveling contact with the supply lines, a step-down transformer carried upon one of said vehicles, a motor generator carried upon said vehicle and supplied with current from said transformer, lamps supplied from the continuous-current side of the motor-generator, storage batteries included in circuit with the lamps, and means in the alternating-current circuit for automatically cutting out the motor-generator and lighting the lamps from the storage batteries upon cessation of the alternating-current.

556,138. ELECTRIC GAS IGNITER; J. P. Doyle, Buffalo, N. Y. App. filed Oct. 29, 1895. An electric gas-igniting burner consisting of a bracket or offset on the pillar of the burner, a valve casing in the bracket or offset, a vertical valve-stem projecting above the bracket and provided at its upper end with a swinging arm having upon its inner end a vertically-actuated electrode, a slotted gravity-cam hinged to the upper side of the bracket for vertically actuating the swinging electrode and a fixed insulated electrode secured to the bracket with its terminal adjacent to the tip of the gas-burner.

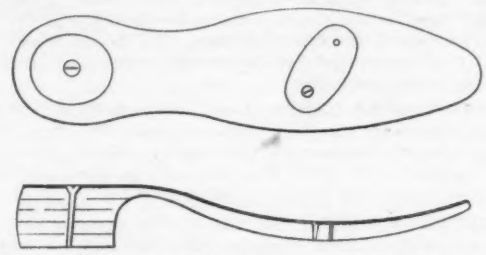
556,139. ELECTRIC BLOCK SYSTEM FOR RAILWAY CROSSINGS; A. E. Ellis, Boston, Mass. App. filed Nov. 8, 1895. In an electric block system for railway crossings, the combination with two or more intersecting tracks, of an electrical conductor for furnishing energy to motor-cars, said conductor being provided with insulated sections on each side of the crossing and with a constantly live section across the crossing, switches for throwing said insulated sections in and out of circuit, electromagnets for actuating said switches, normally open shunt circuits electrically connected with the power supply, and including the said switches and their magnets, and contact closers arranged on the intersecting track upon each side of the crossing, and adapted to be operated by a passing car to first throw the said insulated sections of the electrical conductors out of circuit and afterward into circuit.

555,161. ELECTRO-THERAPEUTIC BODY WEAR; G. Quarrie, Brooklyn, N. Y. App. filed May 3, 1894. A boot or shoe provided with one or more electrical conductors, extending through the sole thereof, in combination with a plate or insole of conducting material having electrical contact therewith. (See Illustration.)

556,176. BRUSH FOR DYNAMO-ELECTRIC MACHINES; F. J. and R. Chaplin, Birmingham, England. App. filed Dec. 10, 1895. The improvement in dynamo brushes consisting of longitudinal wires crimped and grouped together into the required section.

556,185. SNAP SWITCH; A. B. Herrick, Bayonne, N. J. App. filed Nov. 23, 1895. A snap switch having in combination on a main pivoted current-carrying blade and co-operating contacts, a separate pivoted snap-blade beside the main blade in a different plane, and co-operating contact parts or surfaces for the snap-blade out of the range of the main blade, and a spring connection between the main and snap blades.

556,189. ELECTRIC GAS LIGHTING DEVICE; J. B. Jackson, Philadelphia, Pa. App. filed Aug. 15, 1895. In an electric gas lighting device, an arm adapted to be rigidly secured to the cock of a gas burner, an elbow lever having one of its limbs pivotally secured to the outer end of said arm, and having its other limb provided with an electrode, and a spring secured to said latter limb and to a pin on said arm, said elbow lever having in its angle a segmental slot in which said pin is located, said parts being combined.



No. 555,161.—Electro-Therapeutic Body Wear.

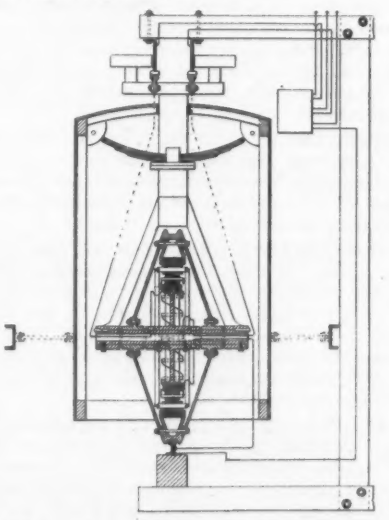
556,210. ELECTRIC RAILWAY; H. C. Reagan, Jr., Philadelphia, Pa. App. filed Sept. 6, 1895. In an electric railway, a feed-wire, and contacts rotatably mounted thereon, said feed-wire forming an axis for said contacts.

556,264. ELECTRIC SWITCH; T. W. Gabel, Lancaster, Pa. App. filed May 13, 1895. The combination in an electric switch of a resistance coil, a series of contacts, each of said contacts having a different point of connection with the resistance coil, a conductor switch formed of a plain lever-bar, an end of said lever-bar having a terminal adapted to engage each of said contacts, a line-wire connected with the fulcrum of the lever-bar, a pair of pivoted conductor switch bars connected by a non-conducting plate, three contacts located within the path of travel of the swinging ends of the connected switch-bars, a second line wire connected with the pivot of one of the connected switch-bars, a conductor connecting the pivot of the said connected switch-bars and one of the terminal contacts of the resistance coil, a connection between the end contacts of said three contacts and connection between one of said end contacts and the actuated mechanism, and a connection between the centre contact of the three contacts and said actuated mechanism.

556,311. CLOSED-CONDUIT ELECTRIC RAILWAY; E. R. Esmond, New York, N. Y. App. filed Oct. 18, 1893. The combination of a trolley rail or conductor section arranged to form part of the motor-circuit, an electro-magnet or solenoid having its coils included in said circuit, contacts in the motor-circuit controlled by the armature or core of said magnet or solenoid, and a counterbalance weight and system of leverage for said armature or core, under the arrangement and for joint operation.

556,320. ELECTRIC RAILWAY; E. M. Boynton, West Newbury, Mass. App. filed March 6, 1895. The combination of a single rail-supported railway car, with a railway structure having one supporting rail, a compound overhead guide or guides consisting of two or more conducting and guiding rails, and an induction motor placed in the car and supplied with a multiphase current from said guides. (See Illustration.)

556,321. ELECTRIC UNDERGROUND TROLLEY RAILWAY; G. D. Burton, Boston, Mass. App. filed Dec. 21, 1895. An underground conduit for an electric trolley railway, comprising a hollow U-shaped casing composed of an inner and an outer shell and webs connecting the upper edges of said shells, said webs having flat bearing-plates for the rails, and said casing being filled with insulating material.



No. 556,320.—Electric Railway.

556,322. ELECTRIC RAILWAY; R. M. Hunter, Philadelphia, Pa. App. filed July 19, 1886. In an electric railway, a slotted conduit, a bared working conductor contained therein, an electrically propelled vehicle, an electric motor on said vehicle to propel it, a collector frame suspended from the axles of the vehicle, and adapted to have lateral movement, transverse guides to prevent said frame from having longitudinal movement, a collector suspended from said frame passing through the slot and making contact with the working conductor extending from the collector to the motor.